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THE TELEPHONE.

FOR some time past a controversy has been kept up, not only in English, but also in foreign, scientific periodicals, with a view of satisfactorily solving the claims of various persons to the invention of the telephone. Bell and Reis are the two inventors who have been brought most prominently forward in connection with the matter, the latter, as all our readers are aware, having a warm and enthusiastic champion in the person of Prof. Silvanus Thompson. We do not wish to express an opinion either one way or the other at the moment, but we desire to draw attention to certain correspondence between Prof. Thompson and Mr. Berliner which has recently appeared in the columns of an American contemporary, the *Electrical World*. The latter gentleman asked the Professor to explain certain statements of Philipp Reis concerning the performance of his telephone, and its defects when used in transmitting speech. To these queries Prof. Thompson replies with much the same arguments as he advances in his recently published book, which we have already reviewed at some length.

Further on he says :—

"In regard to the second difficulty, that in modern telephones for example, the Bell-Blake combination—the vowels are transmitted better than the consonants and notably the 's' sound (which is quite true), I do not see any argument for doubting the correctness of Reis' statement, for the simple reason that if a Reis receiver (with a wire of steel or iron) be used, the consonantal sounds, and especially the 's' sound, come out remarkably crisply. Of course, such a receiver cannot be used on an induction circuit; it is not sensitive enough; and that fact, again, is in favour of the correctness of Reis' statement. For, as a scientific fact, the action of the induction-coil, though it enables the electrician to work with lower battery power and thinner line-wires, is such as to slightly alter *all* the undulations of the currents, retarding them and changing their phases and their forms, and affecting the irregular non-periodic consonantal undulations much more unfavourably than the more regular and periodic undulations of the vowel sounds. Now, Reis did not use an induction-coil. Discard it, and take any good transmitter—Berliner, Blake, Edison or Hunnings—and join it up in direct circuit with a battery and a Reis receiver; the transmission of consonantal sounds will, I warrant, be sharper than (though not so loud as) can be obtained by putting on an ordinary Bell receiver in place of the Reis. The modern difficulty with the consonants arises not from the transmitter, but from the induction-coil and from the magneto-receiver. The latter has so considerable a co-efficient of self-induction in its coil (to put the matter scientifically) and magnet as to damp the finer and more sudden undulations of the current corresponding to the consonantal sounds. So far, then, from modern experience tending to 'greatly weaken the accuracy of Mr. Reis' statements,' I maintain it confirms their accuracy in a most emphatic manner."

We agree entirely with the learned Professor as to the superiority of the articulation of a Reis receiver over that of a Bell, although the sounds emitted are not so loud. We must, however, beg to take exception to his statement, that the former instrument cannot be used on an induction circuit. Our own experience with a "needle" receiver is quite the opposite of that stated by Prof. Thompson. We have experimented with very successful results in a direct circuit, but only on short lines. For long distances, we have, so far, found it necessary to use induction coils, and we have worked through a distance of 80 miles on an ordinary telegraph wire with surprisingly good effect. It appears probable, therefore, that, had Reis used an induction coil with his platinum transmitter—the resistance of which could not vary to such a degree as those made of carbon—he might have been more successful than he appears to have been in his efforts to transmit articulate sounds, or speech.

It is possible, however, that we may have misunderstood Prof. Thompson's true meaning.

THE NEW PATENT LAW.

(*Continued from p.* 274.)

We confidently expect, therefore (as we have before intimated), that the necessity for an early revision of the new Act will become apparent as soon as its innovations have been put to a practical test. In the meantime, while the law is in what we may term its present transition state, patentees will do well not to attach too much importance to the fact of the official acceptance of their specifications; as it is evident from Section 20 of the Act that a patentee, notwithstanding that his application has been passed by the Patent Office, will still be held responsible in the event of its being decided by a judicial tribunal that his claim has not been drawn in good faith and *with reasonable skill and knowledge*. It will be incumbent, therefore, on patentees to ascertain that their claims are properly prepared, with a due regard to the existing state of knowledge, and not to throw the onus upon the examiners of deciding that question for them.

Another word of caution may be of value to the poorer class of inventors who, under the provisions of the Act, may be induced to take out their patents conjointly with a capitalist. A person not versed in the intricacies of the law might infer from the consideration that the patent is granted to himself and (say) his employer jointly, that he is perfectly protected without any preliminary agreement being entered into; whereas, in the absence of any stipulation to the contrary, the employer would be able to use the invention in his own factory and not pay the poor man one farthing, since either of two co-patentees is free to use the invention patented for his own benefit without any payment to the other.

While we are on the subject of user of an invention, we may direct attention to sections 22 and 27 of the Act providing for the grant of compulsory licences and regulating the relations of the Crown to patentees. Under the Act of 1852 the patentee held the right of the use of his invention to the exclusion of every other person, except the Crown. Now it is enacted that the patent is to be good as against the Crown, but the persons administering any departments of the service of the Crown are to be at liberty to use an invention for the services of the Crown on terms which are to be fixed or settled by the Government. Further, the Board of Trade has power to compel a patentee to grant licences for the use of his invention on the petition of any interested party. The pleas which may be urged in the petition are so comprehensive that a person desirous of obtaining the privilege of using a valuable invention will find it no great tax on his ingenuity to furnish evidence that the patentee should be ordered to grant a licence to him on terms to be settled by the

Board of Trade. These provisions tend to seriously depreciate the value of a patent granted under the new Act, as the patentee cannot be said to hold an exclusive right to the enjoyment of his invention if either the public or a Government department may use it without his free consent on terms over the settlement of which he has practically no control.

We cannot, however, conclude this brief sketch without a passing reference to some provisions of the new Act, which are decided improvements in the law—viz., the rendering useless the practice of "racing for the seal," the grant of patents to the representatives of deceased inventors, the extension of the time for the payment of the fees of maintenance on payment of a fine, the infliction of penalties for falsely representing articles to be patented, and for an unauthorised use of the Royal Arms, and last, but not least, the abolition of the practice of granting patents for inventions communicated from abroad.

This last feature demands more than a passing notice. Few persons, except those intimately connected with patent practice, are aware how great an inducement to fraud was offered under, what we must beg leave to call, the *iniquitous* system now being abrogated. Take one example, which is by no means an isolated case. A person residing in Great Britain acquires, by surreptitious means, a knowledge of a valuable invention not yet patented. He, unscrupulous as he is, hesitates to take out a patent for it in his own name as inventor, as he incurs a risk of the fraud being discovered, in which case, even should no worse consequences ensue, his patent will be invalidated. He, therefore, forwards particulars of the invention to a confidential person resident abroad, who then returns the same with instructions to take out a patent for it as an invention communicated by him. A patent so obtained is, under the Act of 1852, perfectly legal, and the first and true inventor has no remedy, since the law does not go behind the scenes to inquire how the foreign correspondent obtained possession of the invention, but on the contrary virtually lauds him as a public benefactor. The abrogation, then, of this system by the new Act is a feature highly to be commended, as what little inconvenience the alteration may entail to foreigners is more than counterbalanced by the additional security from piracy offered to the native inventor.

We have thus directed attention to some of the principal defects as well as useful provisions of the new law. The manner in which the law will work will, of course, depend in great measure on the character of the rules which are to be prepared in order to give effect to its provisions, although, as we have before stated, we are far from sanguine as to the result. It is to be ardently hoped, therefore, that the question will continue to be well ventilated by the press, so as to educate public opinion on the subject, in order that when a further revision of the law takes place—which seems inevitable at no very remote date—the voice of the public may be more effectively pronounced on behalf of such changes, as, whilst recognising the rights of manufacturers to be protected against unjust monopolies, shall be more equitable to genuine inventors in securing them an *indefeasible* protection for their inventions on moderate and advantageous terms, and thus offering them the highest incentive to devote their talents and abilities in promoting the prosperity of their native country.

T. J. HANDFORD.

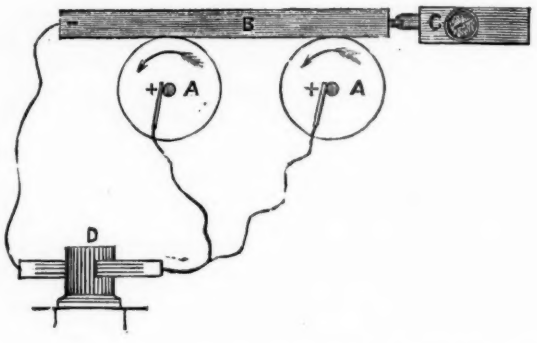
Magnetic Survey.—The magnetic survey party, composed of Lieut. Gordon, R.N., and Mr. Payne, of the Meteorological Service, Toronto, have completed a series of magnetic observations from Prince Arthur's Landing to Qu' Appelle. A complete determination of the variation of the dip of the magnetic needle and of the intensity of the earth's magnetism has been made. Meteorological stations along the line of the Canadian Pacific Railway and on the north-west territories have been established. The party will visit Battleford, where further observations will be made.

ELECTRICAL RAILWAY EXPERIMENTS.

MR. LEO DAFT, of Greenville, N. J., recently found, while making some experiments with an electrical railway, that the traction of the electric locomotive, was far in excess of what was expected, on the basis of precedents furnished by steam locomotives. Subsequently, the influence of an electric current upon the traction was ascertained in the following manner :—

A bar of iron, B, was placed upon two friction wheels, A, A, which revolved in the same direction. A spring balance, C, measured the pull due to the friction between the bar and the wheels.

When an electric current from a dynamo, D, was passed through the points of frictional contact, the pull on the spring balance increased twenty per cent. If further experiments confirm this statement of results,



then it will prove, says the New York *Electrician*, that an electric locomotive will have a traction of twenty per cent. greater than a steam locomotive of equal size and weight ; and, also, the advantage of using the rails instead of independent conductors.

It must be only a question of time before elevated railways are propelled by electro-motors ; and while the elevated road might not be justified in abandoning their extensive locomotive plant in the event of a successful and economical system of electro-motors, yet such an invention would conduce to the introduction of elevated railways in other large cities, as by that means elevated railways would be robbed of much of their objectionable features of dust and noise.

THE SIEMENS-ALTENECK MACHINE IN AMERICA.

NOW that the war of litigation about the Gramme patent is over, with unsuccessful issue to the latter, a campaign of opposition is announced, says the New York *Electrical World*, against one of its descendents —the Siemens-Alteneck dynamo-electric machine, the several types of which have acquired a reputation in Europe that is second only to that of the Gramme machine. In this case the fight is not to annul a patent, but to prevent the granting of one. The Messrs. Siemens neglected to apply for their American patent, because so little interest was taken in electrical applications requiring dynamo-electric machines in this country, at the time the machine was invented by their electrical engineer, Herr von Hefner-Alteneck. But a few years later, seeing the awakening which the American public had experienced in regard to electric lighting, the application for a patent was filed.

Meanwhile, however, the Siemens dynamo-electric machine had found its way into the country. Prof. Moses G. Farmer had imported one of these machines from England to use in experiments for the United States Government at the torpedo station at Newport R. I. The machine had also been copied in substance by some American electricians, among whom Mr. Hochhausen, the same whose modification of the Gramme machine was the bone of contention in the

recent suit. Mr. Hochhausen, then engaged in the construction of dynamo machines, had made several modifications of the Siemens dynamo-electric machine in his endeavour to adapt it to various purposes such as electric lighting and electro-plating. The Western Union Telegraph Company had also imported the Siemens machine, and had copied it for the purpose of adopting it to Mr. Field's system of dynamo-electric telegraphy, for which purpose it still remains in use to-day.

The Western Union Company, not being desirous to become an infringer, has taken upon itself to present evidence to prove that the Siemens machine had been in public use for more than two years before the date of filing the application for a patent, this being the limit accorded by the United States Statutes. The testimony of Prof. Farmer was taken recently at the Rockingham House, Portsmouth, N.H., where the professor is recovering from a recent illness. The machine imported by Prof. Farmer for the government, and which weighs 3,000 pounds, was exhibited and will be sent to Washington, with the testimony, for the convenience of the Examiner of Interferences.

The Western Union has also come in possession of some of the original machines made by Mr. Hochhausen, which are to be used as evidence in the case.

The appearances seem to be very favourable to the Western Union Company so far as evidence goes; but it is premature to decide, because the value of the evidence remains to be ascertained. A good deal will depend on the construction placed on the words "in public use." The granting of a patent to the Messrs. Siemens would bring about a new and interesting complication in the American electric light world. The Edison machine, which, it has always been considered, was untouched by the Gramme patent, would find itself this time surely in jeopardy. The same might be said of the Weston machine. Apropos of the latter, it seems that Mr. Edwin Weston claims to have been himself the original or prior inventor of the form of armature and in fact of magnetic field which are characteristic of the Siemens machine. Furthermore, Mr. Weston is not the only claimant to the priority, for Mr. A. G. Holcomb asserts his right in this direction with equal persistency.

ATKINSON'S TÖPLER ELECTRIC MACHINE.

THIS machine, as described in the New York *Electrician* by Mr. P. Atkinson, A.M., is constructed with two glass plates; the back plate, B, stationary, and supported by hard rubber insulators, while the front plate, A, placed at a distance of about one-quarter inch from it, revolves in the direction of the arrow, on an axis attached to the post at M, through an opening in the centre of the plate, B.

To the plate, B, are attached the brushes, E and F, and the tinfoil and paper inductors, T and X.

In front of the plate, A, one-quarter inch from the glass, are the uninsulated combs, V and H, with their brushes; and the insulated combs, K and L, connected with the Leyden jars, C and D, and the sliding rods, P and R. V and H, are screwed to a brass core at the centre of the hard rubber disc, M.

To the plate, A, are attached the six discs, or carriers, two of which are seen at W and Z.

These parts, with a driving wheel and belt, mounted on a base, constitute the points of resemblance between this machine and others of the same class. The points of difference, covered by patent, are as follows:

1. The outside coatings of the Leyden jars, C and D, are of sheet brass, nickel plated, and are screwed firmly to the base, forming cups into which the jars fit closely, and are thus held in a fixed position, affording a firm support to the parts connected with them, and preventing liability to accident or injury to the jars or plates.

2. The induced current from these outside coatings is conveyed down by the brass screws which attach them, and along copper wires underneath, to the terminals of the switch, S, through which, when closed, it passes from one jar to the other; but, when open, as in the cut, it passes by the brass sockets, seen on the edge, which are also connected with the terminals, out through the conducting cords, and a person, or other object, connected with their outer extremities. As this induced current flows simultaneously with the direct current from the inside coatings, the switch and sliding rods place it completely under control of the operator, either for medical or scientific purposes. With the switch open, a slight separation of the electrodes, P and R, produces a smooth, gentle current; this may be increased to any desired strength, a separation of half-inch producing a current too severe for the strongest nerves. Geissler tubes, attached to the cords, show the beautiful effects of the interrupted current. Also the induced spark below, simultaneous with the direct spark above, is shown when the switch is open about half an inch, as in cut.

3. The brush holders, E and F, are attached to the plate, B, through holes near its edge; thus giving a direct passage to the electricity from the carriers on the plate, A, where it is generated, through the glass, to the tinfoil inductors, represented by the dark shade, and the paper inductors, T and X, represented by the light shade. By passing the electric charge *through the glass, inside its edge*, an insulating margin is interposed between the conductors and the edge, thus preventing loss from leakage, which is unavoidable when the brush holders are attached by clamps or ears *on* edge.

4. The carriers on the plate, A, are of sheet brass, with raised centres, and nickel plated, making them both durable and ornamental. The hard nickel surface is not affected by the action of the brushes or the electricity, while the tinfoil soon becomes defaced; and the carrier, being practically one piece, and its entire surface cemented to the glass, its raised centre cannot become detached, as may happen when the centre is put on separately over a tinfoil base.

5. The combs, V and K, also H and L, radiate at an angle of 45 degrees to each other, from the central disc, M, to which they are attached; so that any possibility of error in regard to their position, or of displacement, is practically impossible.

The following improvements may also be noticed:—

The base is made of two-inch strips, glued together lengthways, and heavy cleats screwed on underneath; giving all the advantages of iron as to freedom from warping, with the insulation and elegant finish of the wood. The iron casting, on which the driving wheel is mounted, slides in grooves on an iron plate, and is moved by the adjusting screw, O, to tighten or loosen the belt. The hard rubber insulators, which support the plate, B, have soft rubber packing, to ease the pressure on the glass. The Leyden jars, C and D, have wooden caps, with cork attached, making a neat ornamental cap, and affording a firm support to the brass conducting rods which support the sliding rods, P and R, and the combs, K and L.

The machine, as here described, has only two plates; but the number is not limited; four or more plates may be used if desired, but better results have been obtained by increasing the size, rather than the number, of the plates. Plates 16 and 18 inches diameter, respectively, make a very efficient machine; plates 25 and 28 inches diameter, make one of great energy; and the smoothness of the induced current is very perceptible in machines of large size.

The energy of the discharge depends chiefly on the size of the Leyden jars, as increased size gives increased storage, and consequently, greater energy and less rapidity of discharge.

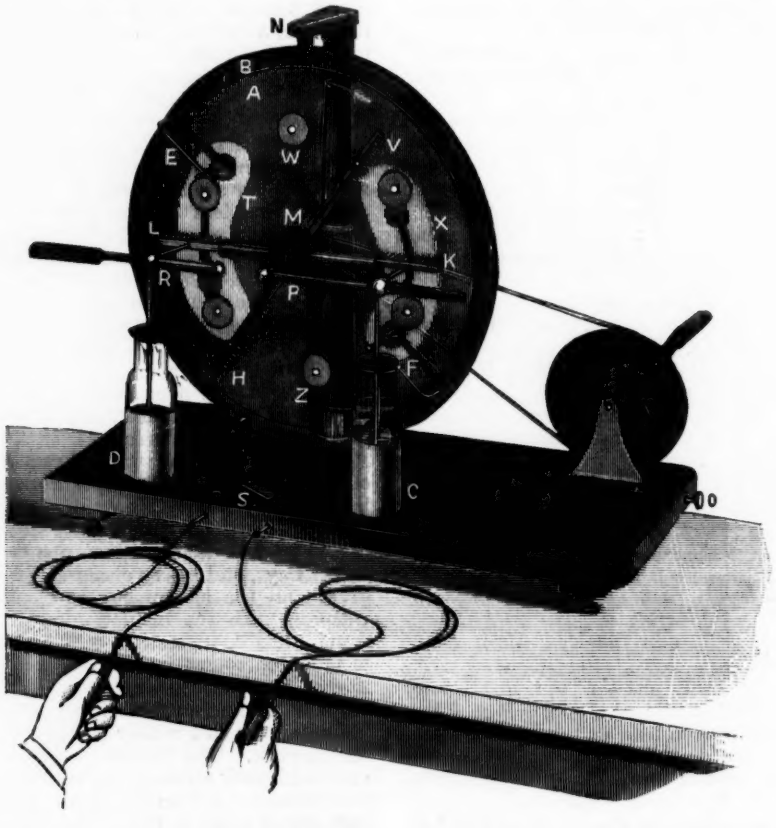
ITS MODE OF ACTION.

Soon after the invention of the Holtz machine, in 1865, an explanation of its mode of action appeared. This was based on the assumption of the dual nature of electricity, and illustrated by a cut of an old style Holtz, made before the application of the "diametrical," or uninsulated combs.

So plausible was this explanation, that scientists

have ever since seemed to rest satisfied with it; and it has been copied into every work describing the machine, and, in some cases, with the same identical old cut, or worse, a cut of the new style, without any explanation of the new appliance.

This theory of the Holtz is briefly as follows:—Supposing the carriers, brushes, and uninsulated combs in the cut, removed, we have, practically, an old style Holtz. The initial charge is given by inciting a piece of hard rubber with catskin, and applying it to one of the paper inductors on the plate, B to X, for example, while the plate, A, is made to rotate rapidly. This charge being negative, induces positive electricity on the front surface of B, negative on the back of A, and positive on the front. As the plate, A, in revolving, passes the insulated comb, K, the positive charge is given off to the Leyden jar, C, and negative received. With this negative charge the plate comes round to the other comb and jar, gives up its negative, and receives positive electricity. Thus, opposite sides, surfaces and



jars become oppositely charged, each acting inductively on the other in geometrical ratio; while a discharge, accompanied with spark and snap, takes place between the sliding electrodes.

This explanation seems very satisfactory for the Holtz, where the initial charge is given on one side only, and from a source exterior to the machine; but it fails to explain the Töpler, whose action is automatic, the initial charge being given by the machine itself on both sides at the same instant.

To comprehend the action of any electric generator, the following essential principles in their construction should be kept distinctly in view.

To generate electricity, is to create a difference of electric potential; the efficiency of all generators, whether batteries, dynamos, or glass plate machines, depending on the difference of potential which each is able to create and maintain within the apparatus itself. And the work to be done by such an apparatus is the restoration of equilibrium, through an exterior circuit; and may consist in producing heat, light, chemical, mechanical, or physiological action.

Let us consider how these principles apply to this machine. It will be seen, from the cut, that as the plate, A, revolves, the raised centres of the six carriers are brought into contact with the wire brushes attached to the holders, E and F, each opposite pair touching opposite brushes, successively, at the same instant. The friction generates electricity, which diffuses itself over the carriers on A, and the inductors on B, with which they are, at the instant of contact, in electric connection. The potential of carrier and inductor, during contact, will be the same; at the next instant the carrier passes on, and is insulated from the inductor, and carrier and inductor now act inductively on each other, and multiply the initial charge given by the friction of contact. As it accumulates it spreads over the paper inductors; these act on the opposite surfaces of the glass till both surfaces of both plates become charged, the initial charge being still continued by the constant friction of the carriers and brushes. But since both sides of the machine are of precisely similar construction, and since the mode of action on both sides is apparently the same, the question arises how any difference of potential or electric charge can be accounted for.

And first, it will be noticed, that the position of the plates being vertical their lower halves are nearer to the earth by their semi-diameter than the upper halves, and, consequently, more under the influence of its inductive action by the square of that distance. A horizontal, or any other position, would not prevent this result; it could only be done by placing them between two worlds of equal size, and equally distant from both. The lower halves are also in close proximity to the Leyden jars, the driving-wheel, and the belt, and subject to their inductive influence; and the plate, B, is supported on *two* hard rubber insulators, while the upper half has but one, and hence has the advantage of the better insulation of the air.

To this lower half of B, and subject to these influences, is attached the brush-holder, F, while E is attached to the upper half, and remote from them. Hence, the carriers brushed by E, and descending towards L, must acquire a higher potential than those brushed by F, and ascending towards K.

An accumulation of electricity must also occur at the lower ends of the inductors, T and X, from the inductive influence of the earth ; and as the brush-holder, F, is placed at the lower end of X, it furnishes an outlet to a portion of this charge, as seen at night by the brushes of light from this holder to the outside of the jar, C, and other parts in close proximity.

The lower end of T, on the contrary, is well insulated, hence the potential of T, from the heavier charge at its upper end, and the better insulation at its lower end, must be much higher than that of X, where the influences are just the reverse.

This accumulation, or high positive potential at the lower end of T, must produce a high negative potential at that point on the plate, A, and its carriers, as it revolves ; and this is shown by the brush of light marking the flow of electricity on to the plate from the uninsulated comb, H ; the outflow of the current received through V from the opposite side and upper half of A. This brush of light extends upward, as the charge increases, almost to the comb, L, showing the high negative condition of the plate and carriers, after having parted with their electricity through L to the jar, D.

And here let it be noted, that a brush of light between comb and plate would have the same appearance whether the flow were from comb to plate or from plate to comb. Hence a similar brush extends upward from the comb, L, as the plate and carriers descend charged from E, and give off their electricity to L.

Following any opposite pair of carriers, as W and Z, we find that as Z passes under the brush, F, W passes under E ; and as Z moves on to the insulated comb, K, W at the same instant arrives at L ; but W, as already shown, has a higher potential than Z, and, at this point, a peculiar adjustment takes place. W gives up its charge through the comb, L, to the inside of the Leyden jar, D. This creates a positive charge on the inside of D, which induces a negative charge on its outside. The electricity, thus repelled, passes to the outside of C, making it positive, and inducing negative on its inside ; and this repelled electricity flows through the comb, K, to the carrier, Z. Z then passes on with a positive charge to the uninsulated comb, V, while W, having become negative, as previously shown, arrives at H. Each now passes under the wire brush attached to its respective comb, and the combs being attached to the brass core at the centre of M, the carriers are put in electric connection with each other, and their potential equalised by the flow of electricity from V to H, so that each arrives at the original position of the other at the same potential, ready to repeat the same process.

The combs, K and V, L and H, have also performed the same office for the several sections of the plate, A, as it has passed them, so that the section from V to E is now at the same potential, from centre to circumference, as the section from H to F, each section having, like the carriers, performed its work on the Leyden jars.

The section from R to H, having given up electricity, has become negative, while that from K to V, having received electricity, has become positive.

This positive potential on the front surface of A at this point induces negative potential on its corresponding back surface ; positive on the front of B, and negative on the back and on the inductor, X. In the same way, but in reverse order, similar conditions occur on the opposite side.

It will thus be seen that while the brushes, F and E, act as generators the brushes, V and H, act as dischargers, and while the combs, K and L, create a difference of potential in the jars, the combs, V and H, like their brushes, discharge, and restore equilibrium.

When the difference of potential between the inner coatings of the jars becomes sufficient to overcome the resistance of the air, a discharge from the inner coating of D to that of C takes place through the sliding electrodes, R and P, and at the same instant a discharge from the outer coatings takes place through the switch and connections, from C to D, to restore equilibrium between them, and thus complete the circuit.

A spark and snap from the resistance of the air accompanies the discharge between the inner coatings, and the same will occur between the outer coatings if the switch is open, but if closed the discharge takes place silently. The plates and other parts being at the same instant relieved of strain there is a restoration of equilibrium in the whole machine.

The above explanation applies to the machine when it is put in operation from a state of absolute rest, but when it is in a high state of activity there frequently occurs a reversal of potential after a discharge, as shown by the reversal of the brushes of light from the combs. To account for this it must be considered that after the primary discharge a residual still remains ; this, from unequal resistance, may be greater on one side than the other, and after being relieved from strain by the primary discharge will operate to give a slight preponderance of potential to that side, which is rapidly multiplied by induction as the rotation of the plate continues.

A reversal can also be produced by touching the inductors, or parts connected with them, while in action, which would reduce the potential at that point. Special conditions may also exist in certain machines which will reverse the ordinary mode of action, as, for instance, a difference of thickness on opposite sides of a glass plate or in opposite jars.

The condition of the air, as to its insulation, influences the whole operation of this machine. An air space insulates the plates, and also the jars, with their rods and balls, from each other : and as a damp atmosphere lessens this insulation, it will decrease the energy of the machine in like proportion. A film of moisture, settling on the plates, will often so reduce the insulation, that the slight initial charge by the action of the brushes is conducted over the damp surface as fast as it is generated ; so that no difference of potential, and consequently no charge, can occur. And as the machine is much more sensitive to such influences than the operator, the latter is often puzzled to know why it will not generate. The simple and effectual remedy, in all such cases, is to dry it. This may be done by a fire, a kerosene lamp, a hot iron, or by the sun's heat, though artificial heat is generally more effectual.

Bright, warm, sunny days, before or after rain, when the atmosphere is loaded with moisture, are the most unfavourable. At such times the plates should not only be dried, but warmed, as moisture will continue to be deposited so long as they are colder than the air.

From this it is easy to see why a Holtz machine is so much more liable to stoppage than a Töpler ; as the Holtz receives only a small initial charge, which is then discontinued, while that of the Töpler is constant, from the continuous action of the carriers and brushes ; so that a well-constructed Töpler is perfectly reliable in any kind of weather.

The views here given are not mere theory, or hasty deductions from imperfect data. They are the result of constant, daily experiment and observation, for several years, with both Holtz and Töpler machines, of almost every conceivable style, size, and variety, including a large number of the very best machines in use.

ON THE RELATIVE PROPORTION OF THE ARMATURE AND FIELD-MAGNET IN THE ELECTRO-MOTOR AND GENERATOR.

By W. MOON.

THE relative size of the armature and field magnet in the electro-motor is a matter that can be decided better by experiment than by induction, yet I trust that the following analogy (which I have not seen before) may not prove without interest :—

If a length of wire (through which a current is flowing) is taken, and it is divided into two portions, and the two portions are caused to attract each other, then the greatest attraction will take place if the wire

is divided into two equal lengths, because the force of the attraction will be equal to the product of their lengths. In a similar manner, if a length of current and a quantity of iron are divided into two portions and made into two electro-magnets, then the force of the attraction between them will be greatest when they are of equal size.

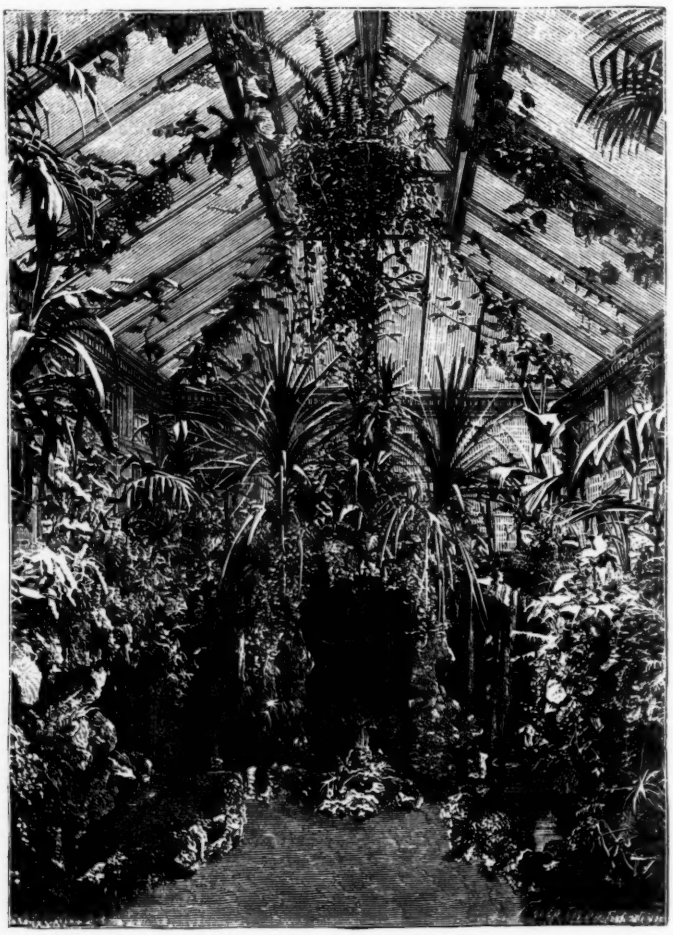
The work that a motor performs is proportional to the velocity of rotation of the armature and to the force of attraction between the armature and the field magnet, but from the preceding remarks it would appear that the armature and field-magnet should be of equal size to produce their greatest attraction. But from difficulties encountered in the construction of dynamos, this law more correctly expressed would be, that the armature and field-magnet should produce equal magnetic fields with respect to each other.

If a dynamo is used as a generator instead of a motor, it may be shown by a method of reasoning similar to the preceding that the energy generated will be equal to a fraction of the (mass of the armature) × (velocity)^2 × (magnetic field); and the generator will perform a certain amount of work with the least possible velocity of rotation, when the current in the armature produces a magnetic field equal to that of the field magnet.

FISHERIES' EXHIBITION.

THE illustration represents the conservatory in the Prince of Wales' Pavilion, which is electrically lighted by incandescent lamps, arranged by the well-known firm of Dick Radcliffe & Co.

The building is of neat semi-Elizabethan old style, the lower portion rough cast, about 2 feet 6 inches high, in the upper portion glazed with clear glass, with muffled squares at head, and a row of leaded glass as top lights. Above the eaves the lantern roof is glazed with Hartley's rolled, which, up to the present, has preserved the ferns and plants without shading, and although there are many difficulties to contend with, the contents are showing an appearance beyond expectation—the object of the firm being to show how effectively a conservatory can be treated in London, without the necessity of continual change or relays of plants, and this, with difficulties which ordinary households do not suffer from, amongst them the unseasonable time for watering, and at times neglect, imperfect ventilation; a person not being in charge to attend to ventilators, at times they are not opened, at others not shut. The interior is surrounded at the eaves by a very pretty and effective cornice or moulding, at the back of which run the necessary wires for distributing the electricity to the lights. The



interior is filled as a fernery, with a continuous pond or stream, into which trickle numerous cascades, rills and waterfalls; at the end a fountain which darts streams of minute crystal drops on to the cavernous roof which supports a huge bed, holding vines, palm, ferns, &c. The cavern is made to represent a Stalactitic cave, lighted by means of a small opening at top, in which are artfully concealed small pieces of coloured glass, which gives great effect to the interior, and a looking glass, capitally concealed, is made to resemble an opening into a rocky corridor or space beyond, through which the water appears to course away. The cave and nooks are at night most effectively lighted by the electric light, so concealed as to give the appearance of subterranean fires, in fact, the water is illuminated underneath from the same source, from the pretty rocks. Gracefully covering the roof, vines are made to act as creepers, and in lieu of lamps glass grapes hang in clusters, concealing electric lights which give

the appearance of luminous grapes growing on natural vines. The appearance of the grapes at daytime is perhaps somewhat artificial; but when the result above described is seen, its conventional appearance by day is easily excused. We venture to hope time will introduce a glass less palpably artificial when viewed without the light. In the centre is hung a hanging basket of flower and foliage plants, which also acts as a chandelier for light by electricity at night, the object of the whole being to show how easily and pleasantly electricity adapts itself to conservatory lighting. The floor is composed of small pebbles, which makes a very pleasant and appropriate finish.

THE BRITISH ASSOCIATION MEETING AT SOUTHPORT.

(*From our Special Reporter.*)

(*Continued from p.* 277.)

MECHANICAL SCIENCE.

Monday, September 24th.

TELEGRAPHIC INTER-COMMUNICATION

By Mr. W. H. PREECE, F.R.S.

The author at the outset described the A B C instrument, introduced by Wheatstone in 1858. In 1861 a company called the Universal Private Telegraph Company was formed to manufacture and supply this instrument to the public. A branch of the company was established in Newcastle-on-Tyne, where, in 1864, the first Exchange for inter-communication that ever existed, he believed, was founded. It commenced with three renters, and these had increased to eight in 1870, when the telegraphic system of the country was transferred to the Government. The system increased so rapidly, and the desire for inter-communication became so general, that a switch for sixty renters was fixed in 1878. The first switch for telephonic inter-communication in the Newcastle-on-Tyne district was fixed in the Newcastle office in May, 1882, the new system being at the commencement confined to the town itself, but it very rapidly extended, and now embraced the whole of the outlying manufacturing districts. It had, however, by no means caused the abolition of the former system, the A B C being still considered by many renters a more reliable instrument for long circuits and for the transmission of important messages. Moreover, it was not affected, like the telephone, by the induction from other wires. Overhearing was impossible, and absolute secrecy was maintained. The Gower-Bell telephone was the instrument used throughout the postal system; it had undergone considerable improvement since its introduction, the result principally of greater care in the details of manufacture. Having described the system of inter-communication, the author explained that the Telephone Exchange at Newcastle-on-Tyne opened with a list of thirty-two subscribers. The average number of exchanges of inter-communication at the commencement was thirty-five per day, and of messages transmitted per day at the outset, eleven. At the present time the number of messages dealt with per day averaged 210, whilst the number of exchanges of inter-communication per day averaged 2,200. The number of offices connected with the Exchange had increased correspondingly, and the list of subscribers now included the names of 333 firms and individuals. Whilst the telephone had found many friends, the A B C had lost not a few, the average number of telegrams dealt with per day on the latter system having diminished to twenty-five, there being a corresponding diminution in the number of inter-communications, which now averaged only twenty-eight per day.

Mr. HAMMOND said he should like to know why the switch board so perfected by the Post Office was not in universal use. It seemed to him a great pity that while their provincial neighbours enjoyed the advantages of the most perfect system of switch, they in London were left with a most vexatious system.

Mr. STOKES found one great disadvantage in the telephone system in London. When in conversation with any one in the other end of the city from that in which he was, he heard a confused noise such as that of the chatter of the operators in the switch room.

Sir FREDERICK BRAMWELL desired to say a word for the United Telephone Company, of which he was a shareholder, as many complaints had been made over its shortcomings. It was only six years since the novelty was introduced, and they now had such complaints of defects in the details of working as he thought might be justifiable if the telephone had been working 60 years. The difficulties of telephonic communication were greatly increased in a place of the size of London, as compared with those in smaller places. He did not think those difficulties were to be put up with, but he did ask those dealing with the telephonic exchange to show some consideration for the development of a system which in principle was only half-a-dozen years old, and in practical application much less.

A vote of thanks was passed to Mr. Preece for his paper.

Mr. PREECE, in replying to the remarks his paper had elicited, said he should be the last man in the world to throw any opprobrium in any shape or form upon the action of the United Telephone Company in introducing the telephone in this country. That company had had the most serious obstacles to contend with; it had had opposition of the most virulent kind. Its patents had been attacked everywhere, and if it had not adopted the latest improvements it was not from its want of will, but from its want of ability to do so. It started on a very small system, and when opponents ceased their attacks and things got settled down, he had no doubt when it found the Post Office had a better system the company would adopt it. Mr. Stokes, in using the telephone in London, thought he heard the chatter of the operators in the switch room, but he (Mr. Preece) did not think he could have done so, as in all switch rooms he had ever been in there had been absolute silence. What Mr. Stokes had heard would more likely be the effects of induction from contiguous wires. The switch board used by the Post Office was not generally adopted, and he thought would not be adopted outside the Post Office for the reason that it was not patented.

MATHEMATICAL AND PHYSICAL SCIENCE.

Friday, September 21st.

Abstracts of papers read by Prof. FITZGERALD, of Trinity College, Dublin.

ON MAXWELL'S EQUATIONS FOR THE ELECTRO-MAGNETIC ACTION OF MOVING ELECTRICITY.

The author points out that Maxwell's equations of the electromagnetic field ("Elect. and Mag.," vol. II., sec. 618) are incomplete, and that the co-efficient of e in the expressions for the components of the mechanical force should not be only $-\frac{d\psi}{dx}, -\frac{d\psi}{dy}, -\frac{d\psi}{dz}$ not P, Q, and R, the components of the electromotive intensity. Maxwell himself makes the same substitution in sec. 631. By means of some of the terms thereby introduced, there result all the electro-magnetic effects of moving electrical charges which are otherwise only casually noticed in sec. 768. These effects come in from the interpretation of the terms $c\,(e\,\dot{y}) - b\,(e\,\dot{z})$, and which are the same as if due to a current, $e\dot{x}$, $e\dot{y}$, $e\dot{z}$.

ON A METHOD OF PRODUCING ELECTRO-MAGNETIC DISTURBANCES OF COMPARATIVELY SHORT WAVE LENGTH.

In order to verify or refute Maxwell's electro-magnetic theory of light, it is desirable, the author explains, to be able to originate disturbances of short wave length. Hitherto, attempts have been made with wave lengths of several miles wave length and, consequently, attempts at refraction or interference would have to be carried on on such a scale as to be impracticable, in order that the refracting surfaces, &c., should be large compared with a wave length. The author proposes to use the rapidly-alternating currents produced when an accumulator is discharged through a small resistance. He showed that currents alternating as fast as 10^8 or more per second might be produced, and as their wave length would be less than three metres, something might be made of them by refraction or interference if there were any feasible method of observing the existence of such very rapidly alternating currents. He thought that anything like Hughes' induction balance receiver would have far too great self-induction, and hoped that some chemical method of detecting the energy might be attainable.

ON THE ENERGY LOST BY RADIATION FROM ALTERNATING ELECTRIC CURRENTS.

The author points out that if variable currents originate disturbances at all like light, their energy must be radiated, and he investigates its amount.

Assuming that the complete expression for the component of the electro-magnetic potential due to an element of current, $c_0 \cos. 2\pi \frac{t}{\tau}. ds$ is —

$$dF = c_0 \frac{\cos. 2\pi \left(\frac{r}{\tau} - \sqrt{\kappa\mu}.\, r\right)}{r}. ds$$

in order that it may satisfy the equation

$$\nabla^2 F + \kappa\mu \ddot{F} = 0$$

the energy per unit of time passing a sphere surrounding a small circular current of radius, a, is

$$E = (\pi a^2 c_0)^2 \frac{8\mu\pi^4}{3\tau^4 v^3}$$

where μ is the specific magnetic inductive capacity of the medium, and τ the period of an alteration of current, and v the velocity of light, $\pi a^2 c_0$ is the maximum magnetic moment of the small circular current, and if we call this m and use electro-magnetic measures, we may take approximately

$$E = m^2 N^4 \times 10^{-29}$$

where N is the number of vibrations per second.

It is evident that unless N be very large, the energy radiated per second will be very small. For example, if N be 10^7, *i.e.*, ten millions of vibrations per second and if the magnetic moment be ninety, there will only be a tenth of an erg of energy radiated per second.

Tuesday, September 25th.

THE IMPERFECTION OF THE GALVANOMETER AS A TEST OF THE EVANESCENCE OF A TRANSIENT CURRENT.

By Professor LORD RAYLEIGH.

In certain electrical measurements a galvanometer is used to indicate whether or not the integral value of a current of short duration is zero. For example, in the method given in Maxwell's Electricity for comparing the co-efficients of mutual induction of two pairs of coils, the evanescence of the integral current through the galvanometer is made the test of the fulfilment of a certain relation between the co-efficients of induction and the resistances. The two primary coils are joined up in simple circuit with a battery. The two secondaries are also connected together in such a way that the inductive electromotive forces conspire, and two points, P, Q, one on each connector, are brought into contact with the galvanometer terminals. In special cases—as, for instance, when the two pairs of coils are similar—there is no current through the galvanometer, whatever may happen in the primary circuit; but in general the establishment, on interruption of the primary current, will cause a deflection of the galvanometer indicative of the integral value of the current passing. The method consists in adding inductionless resistance coils, to one or other of the secondaries until this current vanishes. The required conditions are most readily obtained by supposing the galvanometer circuit broken, and inquiring into the value of the electromotive force, E, between the points, P, and Q. The same current flows in both secondaries, and if x, be the primary current, the equations are $N_1 \frac{dy}{dt} + M_1 \frac{dx}{dt} + R y = E$, $N_2 \frac{dy}{dt} + M_2 \frac{dx}{dt} + S y = -E$, M_1 M_2, are the conductive co-efficients to be compared, R, S, the resistances of the two secondaries (with associated resistance coils), N_1, N_2, their co-efficients of self induction. Thus $(M_1 + M_2) E = (M_2 N_1 - M_1 N_2) \frac{dy}{dt} + (M_2 R - M_1 S) y$. Since y begins from o and ends at o, the integral electromotive force vanishes if $M_2 R - M_1 S = 0$. If this condition is satisfied there is no integral current through the galvanometer, and then the ratio of induction co-efficients is known by the ratio of resistances. In general, however, the evanescence of the integral current is obtained by the opposition of consecutive, positive, and negative parts, and, even although the whole duration of the effect be but a small fraction of the time of vibration, the needle of the galvanometer will be disturbed in such a manner as to make it difficult to say whether or not the whole impulse, acting upon it, be zero. To obtain a satisfactory measurement, it is necessary to secure at least an approximate fulfilment of the second condition required in order that the current may be zero throughout—viz., $M_2 N_1 - M_1 N_2 = 0$. In this there is no difficulty, as we can easily increase the defective self-induction by the addition of other coils placed at a sufficient distance. The most convenient plan is to include two coils by the variation of the relative situation of which the self induction can be adjusted. With moderate care, the initial impulsive electromotive force caused by sudden variation of the primary current, and dependent only upon the induction of the co-efficients, may be made so small that the needle shows no uneasiness when the other adjustment, relative to the resistances, is complete. In March, 1881, I attempted, in conjunction with Messrs. Glazebrook & Dodds, to carry out the plan above suggested for the comparison of two co-efficients of mutual induction. No satisfactory result could be obtained in the ordinary method of working, the needle showing uneasiness, whatever resistances were employed, so that it was impossible to fix upon any particular value as corresponding to a zero integral current. The addition of other coils to increase the self induction of one of the secondaries was so far successful that the needle could be reduced to quietness, but calculation showed that the additional self induction found to be necessary in experiment was much in excess of what the above theory would indicate. The explanation which afterwards suggested itself to me was that the anomalous effect was due to the conducting rings upon which some of the coils were wound, and whose presence complicates the otherwise simple theory. We verified this view by bringing a coil of wire into the neighbourhood of one of the principal coils, the behaviour of the galvanometer being very sensibly different, according as the auxiliary was opened or closed. The kind of embarrassment to which measurements of this kind was subject is well illustrated by placing the galvanometer in a tertiary circuit, not directly influenced at all by the battery current in the primary. A pair of coils of double wires, such as are often used for large electro-magnets, is suitable for the experiment. One wire of the first coil is kept with a battery and forms the primary circuit. The second wire of the first coil and the first wire of the second coil are connected, and constitute altogether the secondary circuit. The second wire of the second coil and the galvanometer form the tertiary circuit. The apparatus must be so adjusted that no effect is perceived at the galvanometer when the secondary is broken, whatever may happen with the primary. When the adjustment is complete the secondary is closed, and the effect is observed of opening or closing the primary. If the contacts are properly made the integral current, through the galvanometer at each operation, is rigorously zero, but in the experiments that I have made no one could infer the effect from the behaviour of the galvanometer needle. The effect may be exaggerated by the insertion of a few iron wires into the induction coil.

THE LATE TELEPHONE PATENT CASE IN THE UNITED STATES PATENT OFFICE.

THE Examiner of Patent Interferences has lately given his decision in a case which has been before him for two years, the official report of which covers 348 printed pages.

Although this decision affects the patents under examination in the United States only, it may not be uninteresting to your readers to learn somewhat of the questions at issue and of the forms of procedure by the officials of the United States Patent Office when the priority of invention is in question.

In this case there were—

Claimants of priority—to wit: A. G. Bell, on one side, and arranged against him were—J. W. McDonough, T. A. Edison, E. Berliner, G. B. Richmond, E. Gray, A. Dolbear, G. Holcombe, C. E. Chinnoch, C. A. Randall, F. Blake, J. Irwin, G. M. Phelps, and W. L. Voelker.

The examiner at first rejected the claims *in toto* of Richmond, Holcombe, Chinnoch, Randall, Phelps and Berliner, and limited his examinations to the claims of the others.

I shall confine my remarks to the claim of McDonough as against one of the claims of Bell, because the decision of the examiner on these two claimants is of great importance.

Before entering upon this special case, I shall briefly set forth the principal clauses of the United States patent laws which governed the examiner in arriving at his award :—

1. "A patent may be obtained by any person who has invented or discovered a new and useful art, machine, manufacture or composition of matter, or any new and useful improvement thereof not known or used by others in this country, and not patented or described in any printed publication in this or any foreign country, and not in public use for more than two years prior to his application for a patent."

2. "The applicant for a patent must make oath before a competent officer that he believes himself to be the original and first inventor."

3. "An inventor may file a caveat, which is a notice given to the patent office of the caveator's claim as inventor, in order to prevent the grant of a patent to another for the same alleged invention. Such caveat then shall be filed in the confidential archives of the Patent Office and be preserved in secrecy, and shall be operative for the term of one year from the filing thereof. The caveat must comprise a specification oath and drawings, like the application for a patent."

4. "An interference is a proceeding instituted for the purpose of determining the question of priority of invention between two or more parties claiming substantially the same patentable invention. The fact that one of the parties has already obtained a patent will not prevent an interference, for although the Commissioner of Patents has no power to cancel a patent, he may grant a patent for the same invention to another person who proves to be the prior inventor."

5. "From decisions of the primary examiner, appeal will lie to the board of examiners-in-chief, or directly to the commissioner, and an appeal will lie from the board of examiners-in-chief to the commissioner, but no appeal lies from the decision of the commissioner."

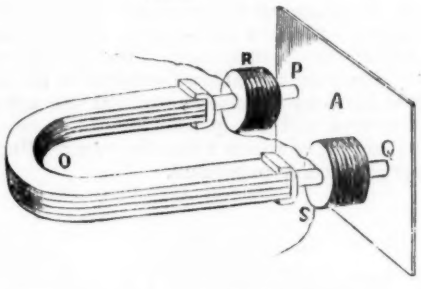
The paragraphs inclosed in inverted commas are taken from the official publication by the United States Patent Office. I shall now attempt to set forth the question at issue between Bell and McDonough.

Bell filed an application for a patent on 14th February,

1876, for "*Improvements in* Telegraphy," wherein he described his method of transmitting signals by means of musical notes, but does not mention the transmission of articulate speech. The instruments made under that patent are not capable of transmitting articulate speech, and it was only after Bell had adapted an iron diaphragm, held in a frame, that his instrument could produce articulate speech, and the evidence of this improvemont appears for the *first time* in his English patent of 9th December, 1876, and subsequently, to wit, on 15th January, 1877, he filed an application in the United States Patent Office, No. 186,787, in which is the third claim, in these words :—

"The combination, with an electro-magnet of a plate of iron or steel, or other material, capable of inductive action, which can be thrown into vibration by the movement of surrounding air, or by the attraction of the magnet." This arrangement is represented by fig. 5 in the drawings.

FIG. 5.



On 10th April, 1876, J. W. McDonough filed a caveat for a "telephone," in the United States Patent Office, which contained a description and drawings of his invention, and the following claims :—

1. "A telephone receiver consisting of the combination in an electric circuit of a magnet and diaphragm, supported and arranged in close proximity thereto, whereby sounds thrown upon the line may be reproduced accurately, as to pitch and quality, substantially in the manner hereinbefore set forth."

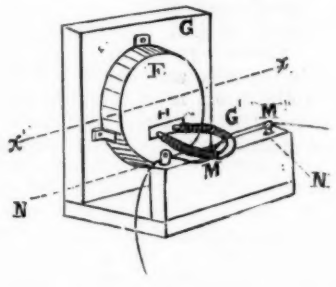
4. "Broadly, the art of transmitting articulate speech by electricity."

5. "Broadly, a variable-resistance contact transmitter."

6. "Broadly, a magneto-receiver for electro-speaking telephones."

The receiver is described in the caveat in the following words, and is represented by the drawing :—

"F, is the receiving or sounding membrane, which is composed of vellum, or any suitable material that is sensitive to the vibrations of sound, and is stretched upon a metal hoop or band, *a'*, secured to the side frame, G, of wood or such like insulating material, of the receiving or sounding apparatus, as shown in figure. G' is the magnet, of a continuous



piece of iron, surrounded by a helix of insulated wire, and connected to the instrument immediately in front of the membrane, F, and at a point near its centre. H is a thin metal armature plate, permanently attached to and supported by the membrane, F, between it and the magnet, as shown in figure, so that the membrane receives the exact and entire motion of its whole area."

On 27th May, 1881, McDonough filed his application in due form for a patent for "Telephones," in which he limited his claims to one only, which is as follows :—

"The combination, substantially as hereinbefore set forth, for a telephone receiving apparatus, of a helix and magnet and connecting posts, to which the wires of the helix are joined, mounted in one end of a frame or holder of wood, or such like insulating material, a membrane mounted on the opposite end of said frame or holder, a portion of the face of which membrane presents a material, attached to and supported wholly thereby, capable of being attracted by the magnet, and in close proximity thereto, so that the said membrane shall be caused to vibrate by the action of pulsations in an electric current in the helix around the magnet, with a sound-recess at the opposite side of the membrane from the magnet, to confine the sounds received therein and exclude exterior sounds from the ear of the listener, and adapted at the same time to allow the ear of the listener to be placed in close proximity to the membrane, all constructed and arranged to operate substantially in the manner described."

It is evident that this only claim of McDonough is for a device or invention identical with that of the third claim of Bell, and the priority of this invention was the subject matter of the contest between Bell and McDonough before the Examiner of Patent Interferences, and the precise question before the examiner is couched in the following words :—"A telephonic receiver consisting in the combination of an electric circuit, of a magnet and a diaphragm placed in close proximity to the magnet, the whole combined in such a manner that the sound transmitted through the wire can be exactly reproduced as to pitch and quality."

The claimants of this particular device were Bell, Edison, McDonough, Gray, and Dolbear.

The experts found upon the evidence that McDonough had made his invention in May, 1875, and the caveat filed on 10th April, 1876 presented conclusive evidence that McDonough had made his invention before any of the other claimants; and upon these facts the examiner of patent interferences awarded priority of the invention to McDonough. From this decision Mr. Bell filed, on 17th September last, an appeal to the board of examiners-in-chief, and I will mention that an appeal from their decision will lie to the Commissioner of Patents, whose decision must be final.

I conclude this, perhaps too lengthy a paper, by quoting the following paragraph from my letter in the REVIEW of 25th February, 1882 :—

"McDonough's patent also describes a magneto-receiver. I invite special attention to the description and drawings of his magneto-receiver, and a comparison of it with that of Bell in his United States patent of January 15th, 1877. It would seem that one was the fac-simile of the other, and as McDonough is the first one on record by nearly a year, it would appear that McDonough was the first inventor of a magneto-receiver—unless, indeed, he be guilty of a charge similar in nature to that made by the wolf against the lamb, of muddying the water up the stream."

W. C. BARNEY.

A NOVEL WAY TO CONNECT A TELEPHONE.*

By J. W. LATTIG.

THE great question among electricians and others interested in the telephone at this stage of its history is, how may we manipulate and in the best way control the great principle or law of induction, to improve the telephone, and make of it even a greater and more useful little implement than it already has become ?

* New York *Electrical World.*

This principle of electro-magnetic induction is one without which the telephone would still be well-nigh, if not entirely, useless—in fact, little more than it was in the days of the now famous Reis—a mere toy for the scientist, an interesting but commercially worthless instrument of the laboratory.

I, therefore, cite below a novelty in the way of telephone connections, touching closely upon this question of induction, in the hope that this account may possibly suggest some ideas to the experimenters of our times; if, indeed, many of them have not already noticed the same thing. I do not claim to have discovered the true remedy for the ailment, but wish to record my plan to reduce extraneous and interfering inductive currents.

I took two Hopkins' transmitters—instruments which, it is claimed, work by intermittent as contradistinguished from the undulatory currents of the Blake and other transmitters, they being the most easily at my disposal, and, withal, I think the best for the trial for various reasons. My line is one-half mile in length, and the instruments were connected as shown in the sketch, in which A and B are the two stations, T and T′ the transmitters, I and I′ the induction coils, R and R′ the receivers. At each end of the line was placed one cell of the ordinary prism batteries.

At station A one element of the battery at that end was connected with the ground, and from the other element for the same battery an attachment was made to the primary of the induction coil, passing through the latter to the transmitter and line, thence to the transmitter, primary of the coil, battery, and to the ground at station B.

The receivers and secondary windings of the coils, instead of being placed directly in the main line, as in the ordinary method, were connected so as to form with themselves a short or local circuit at each station.

With these connections I have been able to secure very remarkable results, which I shall not detail, except to say that I have succeeded in producing speech from the receivers with sufficient loudness to be heard and understood by persons standing several feet away from the receivers, the latter hanging down toward the floor by the electric cord through which they were joined to the secondaries of the coils.

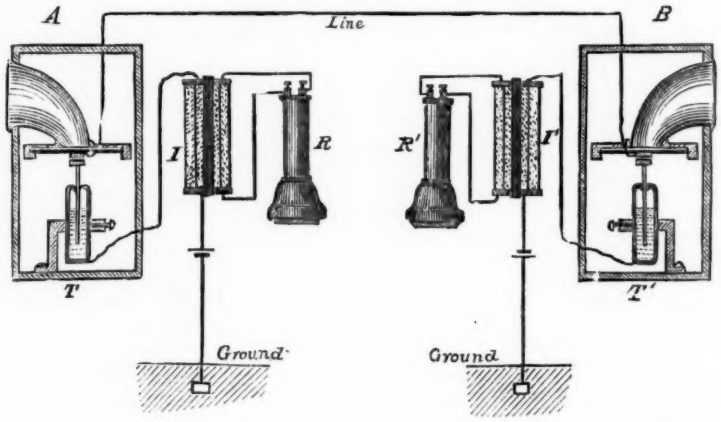
The advantages I claim are: first, the substitution upon the line of direct currents, instead of the usual induced currents, which latter, as is well known, are of very much higher potential, and consequently more naturally disposed to fly off or leave the line wire at every possible chance; every insulator, therefore, favouring the leakage of current in a much greater ratio than they do the direct or lower potential currents; hence the direct currents started on the line by the transmitter at A are much more likely to reach B with a smaller loss of effective force than is the case with those induced.

In fact a great many telephone experts agree that it is necessary to the accomplishment of a higher utility for the telephone that some other current than the induced be used to traverse the line. Secondly, I claim that the outside induction and disturbance from other lines, telegraph, telephone, and electric light, is greatly reduced in the receivers by this method of connecting them, for the very simple reason that the receivers are not placed in the main line, and therefore an induced current coming from a foreign line must of necessity induce another current before they (the receivers) can be affected thereby, and by the time the receivers are reached by this second induction it has been greatly diminished, in the case of strong, first induction, while in the case of weaker original effects its power is entirely lost.

In the Bell plan the receivers are always placed in the main circuit, and consequently respond directly to all induced currents passing on the line, whether from transmitters or from foreign wires, much to the disgust of the operator, and frequently, as before stated, entirely nullifying or destroying their usefulness, until the disturbance or the cause of it has ceased.

THE ST. GEORGE TELEPHONE.

MR. A. F. ST. GEORGE has recently patented a telephonic system, which, in some points of detail, differs from those hitherto brought out. The inventor claims for his system that it enables messages to be readily transmitted for long distances, and that the apparatus is very effective and easily worked, whilst the interference of inductive action upon the transmitting wire or wires is reduced or prevented.



The first part of the invention relates to a form of transmitter. The inventor takes a disc of wood or other suitable organic material and carbonizes it between metal plates, so as to obtain a perfectly flat disc of a uniform character, and having great capacity of resonance by vibration and capable of conducting electricity. This carbonized disc is mounted by its edges in a frame or support between rings, and is placed in a case with an aperture to admit of sound waves impinging upon it. A ball of very hard carbon, hangs by a thin metallic wire or by a flexible non-metallic thread, and this ball is arranged so as to touch lightly against the surface of the carbonized disc. Sounds made to impinge upon the apparatus agitate the disc and the ball touching it so that the ball follows all movements of the disc and always is in contact with it, but whilst the disc vibrates the ball makes small excursions about the surface of the disc, that is to say, any movement of the disc causes the ball to roll about its surface, and this rolling action of the ball brings into circuit, from time to time, fresh points of contact in the path of the current of electricity.

The carbon disc and the ball are placed in circuit with a battery and the primary wire of an induction coil in the usual manner.

Fig. 1 shows the arrangement of the transmitter. *a* is the carbonized disc or plate carried in the support, *c*, between washers, c^1, c^1, and held by the ring, *f*. The ball, *b*, is hung by the wire, *d*, in light contact with the plate, *a*, the electrical current passing through the wire, *d*, the ball, *b*, the plate, *a*, and the conducting wire, *g*, at the edge of the latter.

The second part of the invention relates to a form of receiver for receiving and rendering audible electrical vibrations. It consists of two or more discs of mica arranged parallel with, and in close proximity to, each other and suitably mounted by their edges so as to be free to vibrate. One side of each disc of mica is coated by electro-deposition with metal, preferably silver, and the discs are preferably perforated at their centre. The mica discs are arranged so that the metal side of one disc faces the mica side of the next disc, and so on throughout the series. The discs are connected alternately with each other, one set of the series to one conducting wire of the circuit, and the other set of discs to the other wire of the circuit. With these condenser plates so arranged advantage is taken of molecular strains of the mica forming the dielectric of the condenser arrangement of discs, and such molecular agitations produced by polarization of the mica discs in addition to the attractions to each other of the plates serve, it is said, to increase considerably the audible effects of the receiver.

In order that sounds transmitted or produced by the human voice or otherwise, through telephonic wires, by means of the transmitting apparatus first described, or other means, may be recorded in such form that they may be at any time subsequently reproduced at any distance, the inventor uses a novel form of apparatus

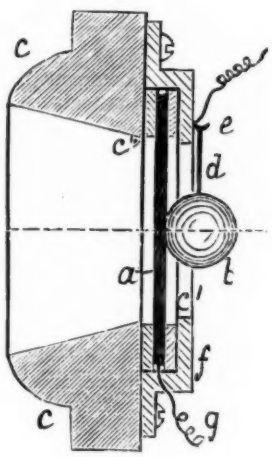


FIG. 1.

consisting of a flat transparent disc of glass or other material, which can readily be fitted up or removed from an axis by which it can be made to revolve in suitable bearings, preferably by means of clockwork or otherwise, by which sufficient uniformity of speed of revolution is obtained. One surface of this glass disc is coated with a film sufficiently sensitive to the action of light of the kind ordinarily known and used in photographic processes, and the disc so prepared is then adjusted upon its axis in a dark chamber. A very small aperture or lens is arranged, through which a beam of light from any convenient source can be directed, so that it falls upon the sensitive surface, and this aperture is made moveable in guides, so that the beam of light can be made to fall upon any point of the sensitive disc between its circumference and its centre, and the moveable aperture is connected to the axis of the disc in such manner that, as the latter revolves the former also travels simultaneously, and the beam of light thus traces a spiral line upon the sensitive surface. The width of the aperture through which the beam of light passes is made variable by means of an elastic or flexible or moveable shutter or diaphragm which is connected to the disc or diaphragm of an ordinary telephonic instrument in such manner that every vibration of the telephonic diaphragm varies to a corresponding degree the width of the aperture. If therefore the telephonic diaphragm be made to vibrate by the human voice or other sound directly, or by the utterances of a receiver telephonic instrument whilst the apparatus is in motion, a spiral line upon the sensitive surface will be affected by the beam of light falling upon it, and the width of the spiral line so affected will vary in exact proportion with the character and strength of each vibration. The message to be recorded for reproduction having been thus impressed photographically upon the sensitized disc the latter is removed and the impression is developed and fixed in the usual well known way. This disc may then be kept until it is desired to transmit or reproduce the message recorded upon it, and it is then replaced upon its bearings and made to revolve in the way already described, whilst a strong beam of light is made to fall upon and follow the variable spiral line upon its surface, and thence (after traversing the glass) upon a receiver of selenium or other substance having the property of varying in its conductivity of electricity in proportion to the degree of light to which it is exposed. This selenium receiver is arranged to form part of an electrical wire circuit, through which a constant current of electricity can be made to pass, and in any desired part of which one or more telephone receivers are situated; and in this way, as the beam of light falling upon the selenium receiver, varies in proportion to the opacity, thickness and width of the photographically deposited spiral line through which it passes, so will

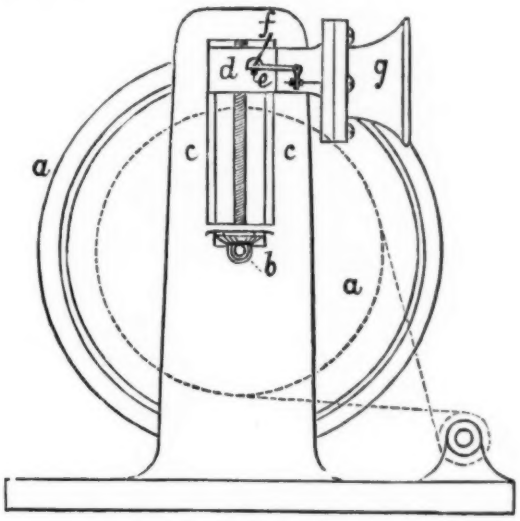


FIG. 2.

corresponding undulations be produced in the electrical current, which undulations will be reproduced in the telephone receivers as audible sounds.

Fig. 2 illustrates this arrangement. *a*, is a transparent glass disc, mounted in bearings at, *b*, and made to revolve at a uniform speed when desired. *c* is a guide in which moves the slide, *d*, having a small aperture at *e*, through which the beam of light is projected upon the plate, *a*. A shutter, *f*, regulates the effective size of the aperture, *e*, and is itself regulated by the diaphragm of a telephone instrument at *g*, to which it is connected, and in which the sounds to be recorded are produced by the voice or by a transmitting instrument at any distance.

When the telephonic signals or messages have to be transmitted by means of submarine or other cables or wire in the immediate neighbourhood of other wires through which electrical telegraph or other currents are also passing, it is necessary to prevent, as far as possible, the effects of induction from such currents upon the telephone wire in order that the messages transmitted by the latter may be audible and intelligible; this action the inventor proposes to obviate by arranging in a convenient situation near the end of such submarine cable (assuming that a submarine cable is being used), an anti-inductive apparatus, consisting of a sufficient number of fine parallel insulated wires in the neighbourhood of the telegraphic or other wires, the inductive action of which upon the telephone

wire it is desired to neutralize. The length and number of such fine wires are to be proportioned so that they are equivalent in inducing power (electrically) to the wire in the submarine cable and are proportioned to the length of the latter. This anti-inductive apparatus is inserted in the telephone wire circuit, its ends being connected to the latter in such manner that any current passing through it moves in the opposite direction to that passing through the cable itself, and its end connecting wires are brought round so as to be sufficiently removed from any inductive action of the telegraph wires upon them.

current induced in them is in the opposite direction to that induced in the telephone wire, *b*, in the cable, *a*. By this arrangement, the inventor claims that any current caused by inductive action upon the telephone wire in the cable, is balanced by the corresponding current induced in the latter in the opposite direction by the inductive action of the telegraph wires upon the anti-inductive apparatus as described.

We observe that Mr. St. George includes in his patent, as a novelty it would seem, the well-known electrophorous receiver of Edison.

The apparatus for reproducing sounds from a

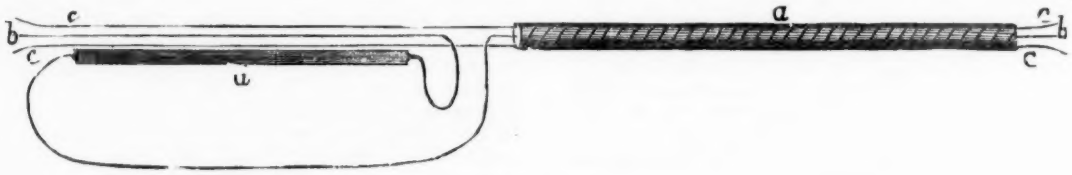


FIG. 6.

Fig. 3 is in illustration of the arrangement just described. *a* is the submarine cable, *b* being a telephone wire, and *c*, *c*, telegraph wires. *d* is a parallel set of fine wires in the neighbourhood of the wires, *c*, *c*, inserted in the telephone wire, *b*, as shown, so that the

photographic record, is, we are inclined to think, hardly practicable, and we should doubt whether the inventor had gone further in this direction than simply recording his idea in his patent specification.

THE VIENNA ELECTRICAL EXHIBITION.

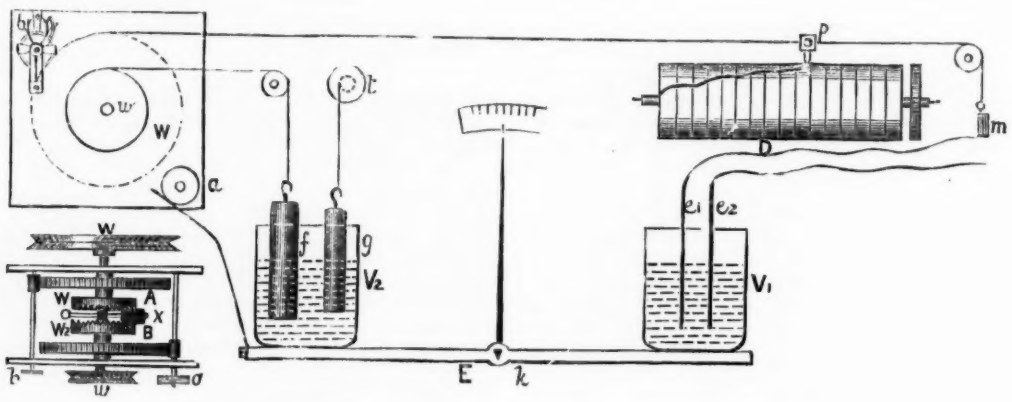
(*Continued from page* 221.)

BREGUET'S AMPÈRE-METER.

THE general principle of this meter is an extremely pretty one; its action depends upon the use of the beautiful differential wheelwork of Redier.

The arrangement of the instrument is shown by the figure. E is a balance beam centred at *k*. V_1 and V_2 are two vessels filled with liquid. Into V_1, two fixed electrodes, e_1, e_2, are plunged; through the latter passes the current of whose strength it is required to keep a continuous record. The decomposition of the liquid into gas causes the contents of the vessel, V_1,

motion is regulated by the escapement, *b*, so that its rotation is very slow. The wheel, B, is turned by a second train of clockwork quite independent of the first, in a direction opposite to that in which the wheel, A, turns; the motion of this train is regulated by the brake wheel, *a*, which can turn freely unless the arm projecting from the end of the lever, E, touches against it and arrests its motion. A weight, *f*, attached to the end of a cord which passes round the wheel, *w*, is immersed in the vessel, V_2. On the wheel, W, a cord is wound which has attached to its further end a small weight, *m*, to keep it tight; this cord has a pencil, *p*, attached to it which rides on the diagram cylinder, D. The latter is kept turning by clockwork, so that the pencil, *p*, traces a line on the diagram paper



to become gradually lighter, and the rate of this loss of weight indicates the flow of the current. The actual object of the mechanism, therefore, is to indicate this loss of weight; this is done in the following ingenious manner:—

W and *w* are two wheels at opposite ends of the same axle; the latter has a small axle fixed at right angles to it with a small pinion wheel, *x*, turning freely on it. This pinion wheel gears into two crown wheels, W_1 and W_2, which are fixed respectively to the toothed wheels, A and B, but which turn loosely on the axle of W and *w*. The wheel, A, is turned by one train of clockwork in, say the direction of the hands of a watch, and its

in the usual manner. The action of the apparatus is as follows:—The wheel, *a*, being prevented from turning by the brake on the lever, E, the wheel, A, which is moving slowly, turns with it the crown wheel, W_1, and the latter, in turn, rolls the pinion, *x*, on the immoveable crown wheel, W_2, thus causing the axle of *x* to move with the latter and slowly rotate the axle of W and *w*. The pencil, *p*, therefore tends to move to the right, but at the same time the weight, *f*, becomes lowered in the liquid, and as the level of the latter becomes raised, the downward pressure on V_2 becomes increased, on the principle of the well-known "hydrostatic paradox," and the lever, E, becomes

depressed; but immediately this takes place the break moves away from the wheel, *a*, and the latter rotates freely under the influence of the train geared to the wheel, B. The latter wheel, therefore, rotates quickly and turns with it the crown wheel, W_2; this rolls the pinion, *x*, round on the wheel, W_1, at a greater rate than the wheel, A, rolls the pinion round on the wheel, W_2, and inasmuch as the two motions are in opposite directions, the wheel, W, and the wheel, *w*, now rotate in the reverse direction to that in which the hands of a watch turn; the pencil, *p*, consequently commences to move from right to left. But the movement of the wheel, *w*, raises the float, *f*, from the vessel, V_2, and this causes the latter to rise again, thus bringing the brake into action and stopping the motion of the wheel, *a*. The original movement of the wheel, W and *w*, now again takes place, and so on. The result of this action is that the pencil, *p*, is continually moved very slightly alternately to the left and to the right; this movement is so small that practically its position on the drum remains unaltered and, consequently, a straight line is traced on the diagram paper, this line being actually slightly zig-zag.

If, however, a current passes through the electrodes, e_1, e_2, then the vessel, V_1, continually becomes lighter and continually tends to rise; this causes the vessel, V_2, to continually drop and unlock the brake wheel, *a*, thus allowing the wheels, W and *w*, to rotate and move the pencil, *p*, to the left. As in the first case, the moment the wheels, W and *w*, rotate so as to move the pencil to the left, the weight, *f*, ascends and by allowing a vessel, V_2, to rise, again locks the wheel, *a*.

It will be seen, then, that the action of the whole apparatus is to cause the position of the pencil to continually alter. If the current is strong, then the pencil moves comparatively rapidly to the left, and thus the line traced by it becomes very much inclined on the diagram; but if the current is weak, then the inclination becomes less. By noting the shape of the curve traced out, it is evident that the changes in the current strength can be observed.

The general object of the arrangement, it may be observed, is to enable sufficient force to be exerted on the pencil, *p*, to move it over the comparatively rough surface of the paper, this force being called into action by the very slight change in weight which must take place in the vessel, V_1.

The weight, *g*, which can be raised or lowered by the thumbscrew, *t*, is for the purpose of regulation in the first instance.

DR. HOPKINSON'S ELECTRICITY METER.

IT is not a little curious that so important a subject as that of electricity meters should have received—comparatively speaking—but scant attention, whilst many of the other details of electric lighting have been overdone. Perhaps the demand for such apparatus is at present so limited that inventors have preferred to turn their thoughts in more profitable directions; but the few who have in the meantime brought their inventive skill to bear upon the instruments will, doubtless, secure the leading positions, when the time has arrived, which shall make electricity meters a necessity. We have, at various times, illustrated the meters of Edison, C. Vernon-Boys, Cauderay, &c., and we now present to the notice of our readers the instrument invented by Dr. Hopkinson. This gentleman's eminent position in the scientific world is a sufficient guarantee that the subject has received due and careful consideration at his hands, and that the apparatus has not been constructed without a thorough knowledge of its requirements. Fig. 1 is a general view of the meter, and figs. 2 and 3, for which we are indebted to Messrs. Chamberlain & Hookham, the licensees and manufacturers, show the details of its construction.

The method of working is as follows:—One of the main leads, say, the positive, enters at one of the binding screws, is wound round the core of the electro-magnet, forming the solenoid, *f*, and leaves at the other binding screw. One binding screw is in contact with the frame of the machine; the other is insulated from it. The shunt circuit, the current in which drives the small dynamo, is taken from the negative lead, enters the machine by a small insulated binding screw (not shown), is carried in series round the magnets and armature of the small dynamo, and is attached to the insulated bar, *h*. So long as *h* remains insulated it is clear that no current passes through the dynamo; but if *h* is put in connection with the frame of the machine a current passes, since the positive lead is also connected to the frame. Now, as soon as a current passes round the solenoid, *d* is drawn down by the magnetic action, *g* falls with it, and touching *h*, puts it into connection with the frame. A current now passes through the dynamo; the governor balls rotate with increasing speed till their centrifugal force is sufficient to overcome the magnetic attraction of the solenoid, *g* then rises again, the current ceases through the dynamo, the speed of the governor falls till *d* is again drawn down by the

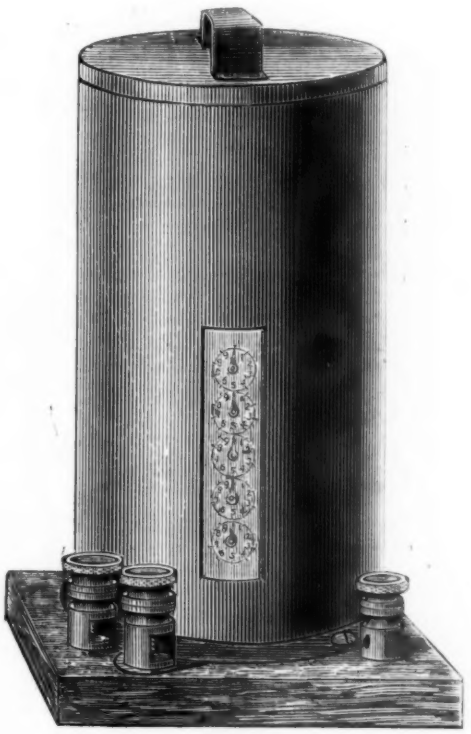


FIG. 1.

magnetic attraction, and the operation described is repeated. Now, it is clear that when a small current is passing along the main leads, *e.g.*, when but few lamps are in use, the attractive power of the solenoid and its iron will also be small; consequently, a comparatively low speed of the governor balls will suffice to overcome it. If, however, many lamps are in circuit, the current will be greater, the attraction stronger, and a higher speed of the governor necessary to break contact. Thus it is plain that there is a relation between the current strength passing along the main circuit and the speed of the governor. It may be seen, further, that they are directly proportional, the one to the other, for the attraction of an electro-magnet varies as the square of the current round it, and centrifugal force as the square of the velocity of rotation. Hence, in the present case the current in the main leads is proportional to the average speed of the governor balls. This speed is indicated, in the usual way, with dials, and, in practice, the machine is standardised so as to register ampère hours.

The range of this meter is only limited by the speed

of rotation which it is possible or advisable to impart to the revolving shaft. The inventor has designed a modification of the present instrument of which the range would be practically unlimited, but it is very doubtful whether this will be called for, as its price would be higher, and it is unlikely that in practice any accuracy greater than that of gas-meters will be found worth paying for. In the meantime, owing to improvements in mechanical detail, each succeeding set of instruments shows an increased range. At first this was from 1 to 20. At present they are producing meters which have a range of at least 1 to 30.

In practice, and from the consumer's point of view, the instrument has the following special advantages:—

(1.) It is read as a gas-meter is read. No electrical

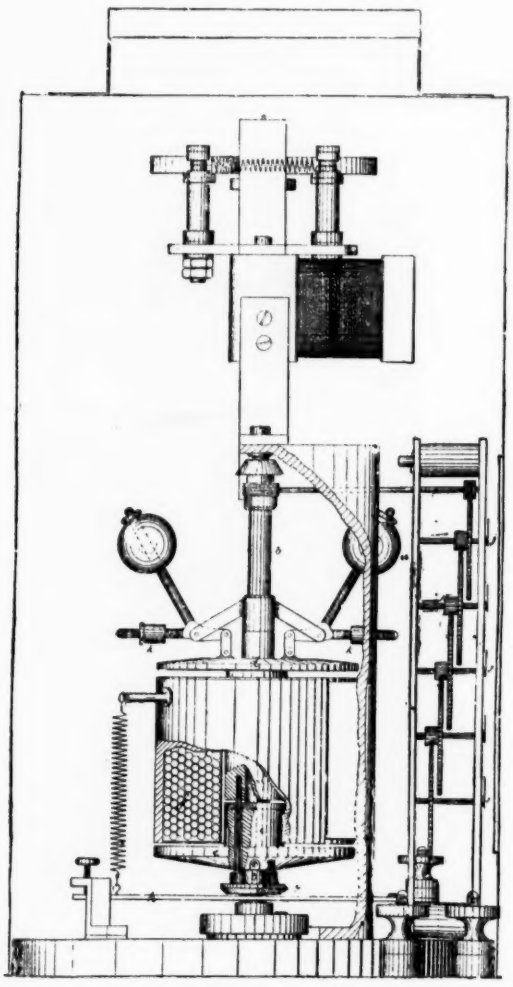


FIG. 2.

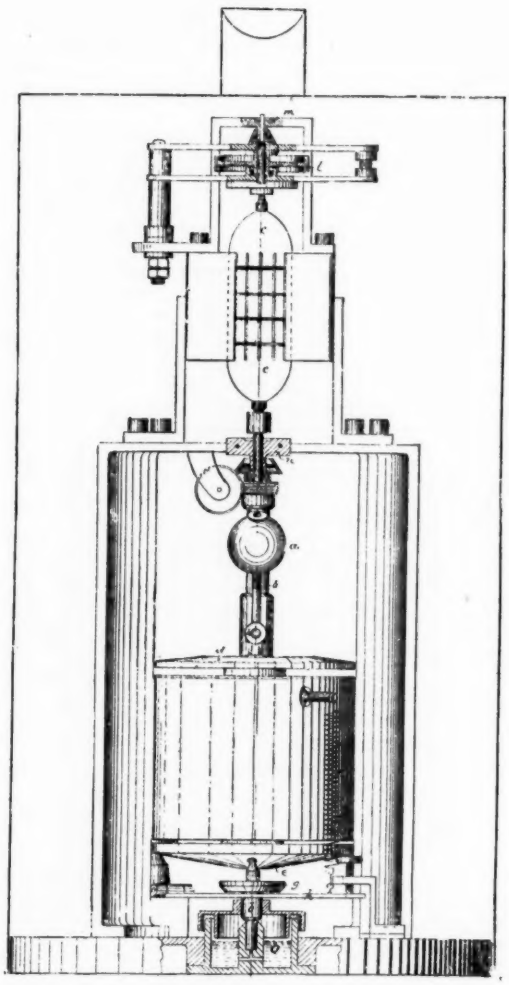


FIG. 3.

or other scientific knowledge is necessary in order to understand its registrations.

(2.) It is not merely easily understood, but a consumer can tell at any moment of the night or day whether his house wires are in order, either by noticing whether there is any movement of the hand when no lamps are in circuit, or by observing whether, with a given number of lamps, a proper current is being registered. Even with an illuminant, to which the public is so well accustomed, as gas, the consumer is often suspicious when the quarterly bill is presented. This would be still more the case with the early use of electricity, and anything which will enable the consumer to judge from time to time what is the amount of his supply will greatly tend to the smooth working of the undertaking.

(3.) The meter is, practically, independent of friction; no clockwork is used in it; and it requires no attention beyond such as the inspector, at his quarterly visit, would be able to give it.

Before closing this notice, another important use of the electricity meter should be referred to. Just as electro-deposition affords a measure of the electric current flowing in a circuit, so the current passing through a circuit of which depositing cells form a part is an exact measure of the metal deposited. This current meter will be found of value to electro-platers in their business. Placed between the battery (or dynamo) and the depositing vat, or vats, it will indicate (1) whether the proper amount of current is passing, and, therefore, whether the battery or dynamo, and the solutions, are in good working condition (2.) By means of a printed table, giving the proper multiplier for each metal, the electro-plater is able to translate the readings of the meter into the weights of the various metals deposited. At present the methods adopted are cumbersome, and at the best uncertain, and in the case of the more expensive metals, the loss is occasionally great. With the electricity meter the measurement is at once easy and accurate.

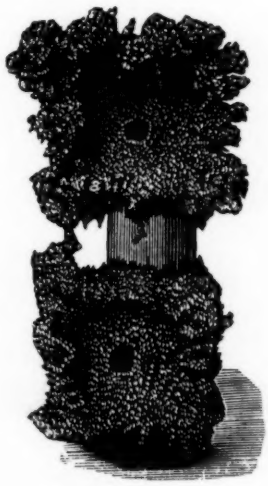
Electric Signals in Mines.—This was the title of a lecture delivered at Redruth by Mr. Sydney F. Walker (of Messrs. Walker & Oliver), in connection with the Cornwall Mining Institute. Mr. Walker dwelt on the advantages derivable from the application of electrical appliances; contended for the superiority of the electric bell signalling system over that at present in use, and urged a more extended employment of the telephone to mining operations.

MAGNETIC INFLUENCE UPON ELECTRO-DEPOSITION.

THE accompanying engraving copied from a photograph represents the result of one of a series of experiments (communicated to the *Engineer*) by Mr. Frederick H. Varley, to ascertain if it were possible to make magnetism build up a structure from electro-deposited metal, which structure should represent the magnetic lines more accurately than the coarse grains of iron filings. The shadow between the poles merely represents the back of the magnet out of focus. The vertical shadow below one corner of one of the poles bears no relation to the experiment.

Each pole of the horseshoe magnet was 1 in. square. The magnet was suspended, poles downwards, in a solution consisting of equal parts by weight of sulphate of magnesia and pure protosulphate of iron dissolved in distilled water, and then diluted down to the specific gravity of 1·26. An iron plate placed at the bottom of the liquid was 1 in. wide by 2 in. long, and 2 in. of liquid were between it and the poles above. A current from two Daniell's cells was used, and the negative or zinc pole connected with the magnet, the positive with the iron electrode. The accumulation represented in the engraving was produced in three days of 24 hours.

It will be seen that the result was completely at variance from that which might have been expected from the well-known effects of iron filing experiments. The north and south poles appear to be isolated, and



the chief deposition is not between them, the latter being the case when iron filings are used. Moreover, instead of a uniform deposit of metal having a smooth surface, a coral-like aggregation of iron atoms took place, and that almost entirely on the margins of the poles. The philosophical conclusions drawn by Mr. Varley from this are, that the current flowing from the dissolving to the receiving pole is deflected by the action of magnetism; this action practically cuts off the current where the magnetic field is the strongest, and the deposit is thus deflected nearly equally to the margins of the poles. Indeed, the greatest deposit is on the outside margins, where the magnetic action is the weakest.

Another experiment consisted in depositing iron on a mercurial surface, when a uniform film of laminated iron was obtained, having a mirror-like surface. A helix was then placed around the receiving and depositing pole, and the experiment repeated. Instead of the uniform film, fine vertical needles of iron parallel with the magnetic axis grew up from the flat iron plate previously deposited, illustrating in another form Groves' experiment with finely-divided iron suspended in a liquid, in which the liquid became less opaque to light during the passage of the current through the helix, in consequence of the particles of iron arranging themselves in the lines of magnetic force.

The reason why, in the experiment represented in the engraving, the iron assumes coral-like excrescences instead of more regular forms, is, according to Mr. Varley, the virtual reduction of the area of the surface of the receiving poles by what may be termed magnetic insulation.

NOTES.

Electric Lighting.—Much satisfaction is expressed by the inhabitants and traders of Grangemouth at the resolution of the Caledonian Railway Company to dispense with the lamps which now light their old and new docks, and substitute the electric light. It is rumoured that the Grangemouth Town Commissioners will follow suit, and electrically light the streets.

The "Cheesewright Railway Electric Light" is, we read, in partial operation on the Great Northern Railway, and carriages are being fitted for it on the South Western, Great Eastern, and some other lines. It dispenses wholly with steam engines and dynamos for its supply, and depends solely on the old voltaic battery with certain novel combinations of elements. An exhibition of this system took place on Tuesday, at 31, Nicholas Lane, the offices of Mr. William Gammon, manager of the South Wales Department of the London and South-Western Railway. Six incandescent lamps, of about six candle-power each, were supplied from a battery of nine cells, and they gave an excellent light. A number of gentlemen interested in the lighting of railway carriages, which is the leading object of the patentees, were present, and expressed decided satisfaction with the steadiness and brightness of the light and the extreme simplicity of the apparatus. It was stated that 18 of these lamps, equal to 160 candle-power, suffice for a Pullman car, that the whole weight of the battery would not exceed 3½ cwt., easily carried beneath the vehicle, and that a single charge would last from 20 to 25 hours. A single installation for a railway carriage would cost from £10 to £12, which is said to be not more than of the first cost of gas. It is claimed further by Mr. Zohrab, the engineer in charge of the apparatus, that the elements employed can be sold after they have done duty in the battery, as chemical compounds, for as much value as they cost in the first instance, and that the price of working would be not more than that of gas and for a superior light.

On Wednesday evening Messrs. Ferranti, Thompson & Ince exhibited one of their 1,000 light machines in action. Only 840 lamps, said to be of 20 candle-power each, were connected up. The results, which we witnessed, do not call for any critical remarks at the moment. It may, however, be interesting to our readers to know that the weight of the machine is given as 1 ton 14 cwt. It is excited by a D 2 Siemens' machine. An Edison-Hopkinson machine, for 500 lamps of 16-candle power each, weighs over five tons. From this it appears that for a given dynamo weight (we will include the exciter in the former case) the working capacity is greatly in favour of the Ferranti. Probably, if space will allow, we may make a few remarks next week on the experiments of Wednesday. In the meantime we may congratulate Messrs. Ferranti & Co. on their excellently appointed factory, which, it is to be hoped, may not suffer from lack of work.

Obituary.—We regret to announce the death of M. Alfred Niaudet at the age of forty-eight years. A member of the Société Française de Physique from its foundation, a co-operator for many years with the firm of Breguet, of which he helped to maintain the scientific fame, an administrator of the Société Générale des Téléphones, of the Compagnie Electrique, of the Société l'Eclairage Electrique, and President of the

Compagnie Internationale des Téléphones, M. Niaudet contributed as much as anyone to the development, in France, of the industries connected with electricity. He contributed to scientific publications various remarkable memoirs on dynamo-electric machines, on telephony and telegraphy, and produced one work, which has become an authority, upon voltaic batteries.

Amalgamations.—The *Bullionist* says:—We are glad to state that our remarks on the apparently unnecessary delay in completing arrangements for the amalgamation of the Birmingham and Warwickshire "Brush" Company, Limited, with the Hammond Electric Light and Power Company, have been productive of good results. We learn, on good authority, that final arrangements for the amalgamation of these two companies have been completed on terms very favourable to *all concerned*. We are also informed that similar arrangements have been concluded between the Hammond and the Yorkshire "Brush." This is a step in the right direction, and the economy which will result from these combinations will materially tend to alleviate the difficulties which electric light companies are now labouring under. The favourable results which may be expected to arise from these amalgamations is fully shown in the sharp rise which took place in the shares of the Hammond Company, they closing at $3\frac{3}{8}$ to $3\frac{5}{8}$, a rise of $1\frac{3}{8}$ per share since the end of last week.

Telephonic.—The Works Committee of the Dundee Police Commissioners, at their meeting on Monday, granted permission to the National Telephone Company to erect 11 news lines in Dundee and two in Broughty Ferry. The National Telephone Company on Monday opened a Central Exchange in Broughty Ferry. After the orders on hand are executed there will be upwards of 50 connections.

The same company's submarine line between Dundee and Newport (Fife) was opened for traffic on Tuesday.

Telephones in Mines.—At the exhibition of the Mining Institute, at Redruth, the two halls in which the exhibition was held were placed in direct telephonic communication with the 150-fathom level in Pednan-drea Mine, which is situated at the head of the town. The work was carried out under the personal superintendence of Mr. T. Scott Anderson, the representative of the United Telephone Company. Mr. Henderson and many other mining officials in the district have spoken in such high terms of approval of the apparatus, and of its use as a means of direct communication between surface and underground, that steps are not unlikely to be taken for its early introduction into some of the principal mines in the county.

The Telephones of the World.—According to a German statistical periodical, in the year 1882 telephones were in use in the whole world in 303 towns, the subscribers numbering 78,808. This number is divided as follow:—Europe, 161 towns, with 30,066 subscribers; America, 126 towns, with 47,185; Asia, 7 towns, with 420; Australia, 5 towns, with 897; and Africa, 4 towns, with 240. The European towns having telephones are divided as follows among the different countries;—Great Britain, 75 towns, with 7,287 subscribers; Germany, 21 towns, 3,613 subscribers; France, 18 towns, and 4,437 subscribers; and Italy, 13 towns, and 5,507 subscribers. There is, therefore, an average of 424 subscribers for every town in Italy, 247 in France, 172 in Germany, and only 97 in Great Britain. The United States has 112 towns with telephone stations, and 41,569 subscribers.

Telephone Extension in Scotland.—Within the past year or two there has been a great extension of the telephone system in Glasgow. When the different interests were amalgamated in March, 1881, in the National Telephone Company, there were 290 exchange subscribers, while now there are 650 exchange and 200 private lines. In Glasgow there are now six exchanges, all of them being connected together by trunk wires. The principal exchange is in Queen Street, and in connection with it there are about 400 subscribers. In this place there are eight boards, each giving communication with fifty subscribers, while all the boards are intercommunicated, so that a subscriber in one may be put in connection with a subscriber in another. There are two operators at each of the boards—nearly all of them being young ladies. There is no noise of ringing of bells, or anything of that kind; but when a subscriber calls a small disc falls down, and thus attracts the attention of the operator. The Exchanges are open night and day. Communication can be had with Edinburgh and Leith, Greenock and Paisley, with the Ambulance Association, the infirmaries, most of the public buildings, and many warehouses, offices, and public works; while there are many private lines from Glasgow to places ten, twenty, or even thirty miles beyond the boundary. It is interesting to notice that each subscriber calls up another five times a day, and allowing for five replies, a telephone is thus used ten times a day; but some subscribers use their telephones fifty or sixty times daily. Some times as many as 4,000 connections are made in one day. The company have now obtained a concession from the Postmaster-General, by which a reduced tariff can be charged for intercommunication between the large towns and cities and Glasgow. The telephone is in great demand in Dundee and the surrounding district, and every week brings to the National Telephone Company additional subscribers. The Dundee and District Company, too, are doing a good business. At Aberdeen the number of subscribers to the National Telephone Company's Exchange is upwards of 250, in addition to which a number of private lines are rented. In Edinburgh and Leith the number of subscribers is not so large as might be expected; nevertheless, good progress is being made, and last week the switch table accommodation at Leith was doubled to meet the requirements of subscribers. We understand that Mr. Bennett, the manager of the National Telephone Company, after a personal examination of the working of the Exchanges under his control, has decided to make a number of alterations which are well calculated to extend the use of the telephone, and these improvements, when completed, will doubtless attract a large number of new subscribers.

Rival Telephone Companies in America.—A suit has been begun by the American Bell Telephone Company and others, against the Molecular Telephone Company and others, on a motion for a preliminary injunction to restrain the defendants from making and using their instruments, which are claimed to be an infringement of the patents of Alexander Graham Bell. The defendants' answer has been filed. It is long and voluminous, its principal points being a denial of Bell's claim that he was the original inventor of the speaking telephone, and a denial that the invention as described by him in his claim for a patent was patentable, on the ground that it was not a useful or practicable invention. The Defendants set up that Bell's patents were fraudulently obtained; that Reis, Drawbaugh, McDonough, Gray, and others, had previously invented telephones covering the principles claimed by Bell, and that by virtue of Reis's discovery the telephone is open to the public. We may mention here that during the month of September the output of Bell telephones in America is estimated at 5,200 instruments.

The Commercial Value of the Telephone.—Advices from America state that the Bell Telephone Company is now believed to be earning about sixteen per cent. on the stock, while paying twelve per cent. Its experimental line will soon be completed, and the possibilities of long-distance telephoning demonstrated.

Overhead Telegraph Wires.—At the Wandsworth Police Court on Wednesday, Mr. Paget had under consideration 17 summonses which had been taken out at the instance of the Postmaster-General against the Wandsworth Board of Works, a difference having

arisen between them in respect of placing posts and wires in certain parts of their district. Evidence having been taken the hearing was adjourned.

Sixpenny Telegrams.—In contemplation of the successful adoption of the cheaper rate of public telegrams in October next year, the authorities are making active preparation for additional spare instruments and instructors at their schools in Moorgate Street to enable them to provide for a regular daily attendance of 100 or 120 telegraph learners. Hitherto only about 50 boys and 30 girls have usually been in training there, while during the 12 or 13 years the schools have been in existence over 3,000 male and female clerks have been taught the rudiments of postal telegraphy.

H.M. New Cable Ship "Monarch."—We read the following in *The Glasgow Herald* of the 11th inst.:—"This fine vessel, which was launched about seven weeks ago from the shipbuilding and engineering establishment of Messrs. David J. Dunlop & Co., Inch Works, Port Glasgow, left the builders dock on Tuesday afternoon for the Tail of the Bank. She proceeded to the Gareloch to adjust compasses early yesterday morning. Returning to Greenock, she received on board a large company of ladies and gentlemen, and proceeded down the Firth, as far as Brodick Bay, on her official trial run on the measured mile. Her performances here were such as to fully justify the most sanguine expectations of all concerned in her construction. The speed attained on the mean of the several trials was considered highly satisfactory, being 12 knots per hour. The vessel has been built to the order of Her Majesty's Postmaster-General for laying and repairing telegraph cables in British waters, and is of the following dimensions: — length, between perpendiculars, 240 feet; breadth, moulded, 33 feet; depth of hold, 18 feet 2 inches. On account of the special service for which she is to be wholly employed special attention has been given to her construction. She is strongly built of iron, but to no class, her design and internal arrangements being such as to require a distribution of strength considerably in excess of that which would be required for vessels in the merchant service of similar dimensions. She has been fitted by the builders with one pair of compound inverted cylinder engines of the collective indicated power of 1000 H.P. The cylinders are 30 inches and 58 inches in diameter respectively, the length of stroke being 48 inches. She has two main boilers 4 feet in diameter by 9½ feet long, and an auxiliary boiler 9 feet 4 inches in diameter and 8 feet 4 inches long. Among others present on the trial trip were Messrs. Graves, David Lumsden, and W. S. Culley, of the Post Office, Messrs. D. J. Dunlop, Ritchie, Captain R. Draper (of the *Monarch*), and a select party of ladies and gentlemen invited by the builders. The anchors were cast down the Firth, and the tables were spread for dinner. Mr. David J. Dunlop occupied the chair, and Messrs. J. H. Ritchie and D. Lumsden acted as croupiers. Mr. Graves, in proposing 'The health of the builders and the architect, Mr. Ritchie,' said he believed it was customary to propose the health of Her Majesty first, on all such occasions as that, but they might be excused if they departed from the common custom on the present occasion, seeing they were on board the *Monarch*, and under their monarch's flag. They were to-day the guests of the Messrs. Dunlop, the builders of the vessel, and while he was prepared to congratulate them upon the ship in the present fine weather, he had no doubt she would be quite as suitable under more adverse circumstances. The *Monarch* had been built with an eye to the special services to which she had been dedicated, and he believed she was admirably constructed to realise the hopes of the promoters. The builders had done everything they could to conduce to this; they had done more than their contract bound them to do, they had done all in their power to make it a complete success, and to the comfort of all of us. The architect had designed the lines of this vessel in a way in which he thought could hardly be found fault with. The internal arrangements and the whole structure were magnificent and complete, and there was every reason to believe that she would stand the test in a storm as well as she had done in calm water. Mr. David Dunlop, in the course of his reply, said that if he had turned out a good vessel it was from the kind assistance given to him by the gentlemen in connection with the post office, who came to Port Glasgow, and among them he had to thank specially Mr. Culley, Mr. Lumsden, and Mr. Ritchie. He trusted that in the work the vessel had got to do she would be successful, and he expected that before long the Government would require more ships for the same work, and he would be very glad to have the construction of them. Mr. Ritchie, the architect, said he could only second everything Mr. Graves had said about Mr. Dunlop, and he ought to mention how much he had appreciated the kindness shown him by the firm during the building of the *Monarch*."

The Submarine Cables Conference.—Mr. C. M. Kennedy, C.B., of the Foreign Office, Mr. C. Cecil Trevor, C.B., Assistant-Secretary to the Board of Trade, and Mr. C. H. B. Patey, Third Secretary to the Post Office, have, we believe, arrived in Paris as British delegates to the Submarine Cables Conference. Lieut.-Col. Bateman Champain, R.E., will be delegate for British India, and Sir Charles Tupper, K.C.M.G., delegate for the Dominion of Canada, at that Conference. Mr. H. Farnall, of the Foreign Office, will act as secretary to the British delegates. The German delegate is Professor Danbach.

Currents in the Atlantic.—We are informed from Santa Cruz de Tenerife that within the last month a large buoy, about 12 feet high by 8 feet in diameter, has drifted ashore on the N.E. coast of Tenerife. This is rather interesting as showing the drift of the currents in the Atlantic Ocean. The buoy carries the initial letters $\frac{\text{U. S.}}{\text{L. H. E.,}}$ and it is thought, therefore, that it must have something to do with the United States Lighthouse department. It has, further, a large ball, weighing over a hundredweight, attached to the bottom by a chain, and so does not seem to be a cable-buoy. It would be very interesting to know how long it has taken this buoy, since breaking from its moorings, to arrive at Tenerife.

An Atlantic Cable.—Another cable company it is reported has been formed in New York to lay two cables between England and America. Mr. Thomas James, formerly Postmaster-General, is to be president of the association, which will possess 6,000,000 dols. capital, held in both countries; an equal amount of bonds is also to be issued for the construction. The American landing place for the cables will be at Long Island, and the rates for messages will be much reduced.

The Turin Exhibition.—The Italian Consul General in London intimates that he has received a communication to the effect that at the Italian General Exhibition, to be held next year at Turin, the authorities have decided on making the portion of it appertaining to electricity, international, and therefore invite the concurrence of other nations.

Gas v. Electricity.—At the half-yearly meeting of the Commercial Gas Company, held at the Cannon Street Hotel on the 5th inst., the chairman—Mr. R. Bradshaw—said an important reason for the company reducing the price of gas from 2s. 10d. to 2s. 8d. per 1,000 cubic feet, as from January 1st next, was that they would be better enabled to compete with the electric light. The electric light companies had not been idle, but had applied and obtained provisional orders for lighting large areas within the districts of the metropolitan gas companies, including the district of the Commercial Company; and they must not shut their eyes to the fact that the electric light would possibly be competing with them, and the best way of

meeting the competition with success was to reduce the price of gas. In bringing the price down they had not much to fear from the competition of the electric light companies.

Why the Electric Light Cannot Compete with Gas.—Alderman Bower, speaking at the recent dinner of the members of the North of England Gas Managers, at Leeds, said he for one would not deny the beauty of the electric light, yet he recognised the fact that at present its great cost would exclude it from general use. Time might overcome this obstacle, but there could be no doubt that the competition between gas and electricity was a healthy competition. Electricity came into the field handicapped, because it gave nothing but light, whereas from the manufacture of gas were derived residual products which in themselves were valuable. Gas, he held, was still in its infancy, and was capable of great development.

Forthcoming American Electrical Exhibition.—An exhibition of electricity and electrical appliances will be held in Philadelphia, United States, commencing on Tuesday, September 2nd, 1884, under the auspices of the Franklin Institute of the State of Pennsylvania. From the fact that the projected exhibition will be the first in America exclusively devoted to this progressing branch of science, this announcement has attracted unusual interest throughout the United States, and the exhibition will afford an admirable opportunity of witnessing a representative display of American discovery and invention in electricity. It has been determined, however, to give it an international character. The importance of the project having been properly represented to the Congress of the United States, an Act was passed to this effect, and articles intended for the exhibition will be admitted to the States free of duty. All applications should be made to the Secretary, Franklin Institute, Philadelphia, U.S.A.

The Edison-Hopkinson Dynamo.—In our issue of the 15th ult. we published a full report of important tests which had been made at Manchester on a 200-light machine of the Hopkinson-Edison type. The Edison Electric Light Company has just issued a pamphlet in which a concise and brief description of the improved machine is given. Dimensions, safe lamp load, weight, speed, current, &c., of various sizes of machines are fully set forth, together with a list of vessels which have been fitted up with the Edison incandescence lamp. We would recommend our readers to apply for a copy of the pamphlet, which is of an interesting character beyond mere advertisement.

NEW COMPANIES REGISTERED.

American, British, and Continental Cable Company, Limited.—Capital, £1,500,000, in £10 shares. Objects :—To establish and maintain telegraphic communication between Sable Island and any other point or points on the Canadian shores and such point or points on the coasts of Great Britain and Ireland and the Continent of Europe as may be determined; and from any point or points on the Pacific Coast of Canada to Japan and the Continent of Asia. Also to connect the company's cables with the internal telegraphic systems of Canada, or of any other country. Signatories (with 100 shares each) :—Alderman Simeon Charles Hadley, 5, Knightrider Street, E.C.; Le Comte Alfred Havier de la Chapelle, 217, Rue St. Honoré, Paris; J. W. Adamson, 34, Leadenhall Street; E. J. Francis Davis, 24, Grafton Street, Piccadilly; John Bennett, Serjeants' Inn and Waddon, Surrey; M. G. Bohrer, 121, Fenchurch Street; R. Barker, Morialta, Forest Hill. The signatories are to appoint the first directors—qualification 100 shares, or £1,000 stock; remuneration, £5,000 per annum, and such further sum as the company in general meeting may determine. One-third of the profits in each year is to be carried to a "Cable Renewal Fund," until such fund shall amount to £300,000. Registered 12th inst. by Ingle, Cooper & Holmes, 20, Threadneedle Street. Registered office :—Bartholomew House, Bartholomew Lane, E.C. Secretary *(pro tem.)*, W. P. Daniels.

Hygienic and Electric Association, Limited.—Capital, £12,000, in £10 shares. Objects :—To acquire the business of the Universal Hygienic and Electric Association, of 3, Mall Road, Hammersmith, and to manufacture and trade in all kinds of goods to which electricity may be applied—particularly stays, corsets, brushes, combs, and medical compositions. Signatories (with one share each) :—W. G. Totterdell, Landport; O. P. Boret, 21, Soho Square; W. G. Tuck, Portsmouth; E. G. Totterdell, Landport; S. Royle, Buckland, Hants; W. Tuck, Portsmouth; W. H. de Carteret, Woking Station, Surrey. Registered 13th inst., by Charles Doubble (registration agent), 14, Serjeants' Inn, Fleet Street.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Electro-Amalgamator Company, Limited.—An agreement, dated 12th ult., was filed by this company on the 15th, by which it is stipulated that the new company shall discharge the debts and liabilities of the old company, and shall keep its liquidator indemnified against all its debts and liabilities, and against the cost and expenses of winding-up. Every shareholder in the old company will be entitled to require the new company to allot 120 shares of £5 each (fully paid) in respect of each old share.

National Company for the Distribution of Electricity by Secondary Generators, Limited.—The statutory return of this company, made up to the 26th ult., was filed on the 2nd inst. The nominal capital is £500,000, in £10 shares. The number of shares taken up is 727, upon which the full amount has been called, the calls paid amounting to £6,630, leaving £640 unpaid. Registered office: 18, Warwick Street, Regent Street.

Union Electric Light and Power Company, Limited.—The second return of this company, made up to the 9th inst., was filed on the 12th inst. The nominal capital is £30,000, in 300 shares of £100 each. 257 shares have been taken up, being an increase of 107 over those issued last year. The full amount has been called up and paid, the total paid-up capital being £25,700. Registered office: St. Stephen's Chambers, Telegraph Street.

BILLS OF SALE FILED & RE-REGISTERED.

D'Humy, Paul Raoul de Faucheux, electrician, 2, Carlton Mansions, Clapham Rise, Clapham, to William Furber and others. Dated October 5th. Filed October 6th. £250.

Kent, John, telegraphic engineer, Trent Villa, Netherwood Road, West Kensington, to Wm. W. Cooper and another—settlement of policy and furniture in trust for wife and children. Filed October 21st, 1878. Re-registered September 29th, 1883.

CITY NOTES, REPORTS, MEETINGS, &c.

The Yorkshire Brush Electric Light and Power Company, Limited.

THE annual general meeting was held at the Cannon Street Hotel on Thursday of last week, Mr. H. W. Lowe presiding.

The Secretary (Mr. G. L. Morton) having read the notice convening the meeting,

The Chairman, in moving the adoption of the report, said that but for the probability of bringing to a successful issue the negotiations for an amalgamation of their undertaking with that of another company, he should have considered it necessary to go fully into their position. As an illustration of what electric lighting might have become but for the impediments which had been thrown in the way of its progress, he thought he might refer to the company's works at Middlesborough. The lighting there was giving every satisfaction to their consumers, and it was financially successful. As regarded the amalgamation, it was a very essential proceeding for them to consider, and he was glad to

say that, after long and tedious negotiations, they saw their way clear to bringing it about, and on terms which he felt certain would be considered satisfactory by the shareholders. In a few days he hoped the scheme would be laid before them.

Major-General J. Bates having seconded the motion, a discussion followed, in the course of which,

Mr. M'Alister, while casting no blame on the Board, and regarding the balance-sheet as perhaps more satisfactory than the shareholders had a right to expect in the circumstances, complained of the assurances which the directors gave at the last special meeting as to the results of the year's working. Instead of saving their capital, they had since then lost about 6 per cent. of it.

In reply to questions, the Chairman stated that thirty-one lamps were now at work at Middlesborough from a 40-light machine, and they were producing a rental of £25 per lamp. The consumers were pressing for a reduction in the price, and as an inducement to a greater use of the light, the directors had promised to reduce the price by £5 a lamp as soon as the consumers took off another forty lights. The remark as to giving up the London offices would require serious consideration if they had been intending to carry on the company in its separate existence. They had reduced the staff to a minimum, but it was necessary for a company seeking business to keep a staff to be ready to take work up which might be offered them.

Lieut.-Colonel H. C. Byrde (a director) testified, from personal inspection, to the admirable situation of the works at Middlesborough for the lighting to be done there. The capital which would be required to supply the whole of Yorkshire with electric lighting would not be £20,000, but £1,000,000. After going to considerable expense in preparing plans and estimates for supplying the Leeds Corporation with the light for their public buildings, the Corporation finally decided to give up the idea for the present.

The Chairman, in further replying, stated that they had been seriously prejudiced by litigation. From the time the petition for winding up the company was lodged it gave them such a bad name in Yorkshire that no one would look at any offer they made, saying, "You are going to wind up." This litigation went on for two months at least, and during the whole of that time they could undertake no contracts. The working, however, at Middlesborough showed a profit, and was a very good field in itself. The £65,000 on the credit side of the balance-sheet represented simply the price of the concession. It was put in sterling, but it existed principally in shares. He believed, speaking roughly, that they had made a profit altogether of from £700 to £900.

The resolution was carried after the withdrawal of an amendment postponing the adoption of the report until the meeting to be called concerning the projected amalgamation; and subsequently the retiring director and auditors were re-elected.

A meeting of the company will be held on Tuesday to consider the proposal to amalgamate the company and the Hammond Company. The agreement to be submitted to the meeting provides for the amalgamation on the terms of the Hammond Company surrendering to the Yorkshire Company the 17,060 fully paid-up shares in the Yorkshire Company which it still holds, and also agreeing to allot and issue to the Yorkshire Company for distribution among its shareholders fully paid-up £5 shares of the Hammond Company in the proportion of one fully paid-up £5 share of the Hammond Company for every six £2 fully paid-up shares in the Yorkshire Company. The Yorkshire Company will, in consideration of this, transfer to the Hammond Company all its undertaking, property, assets and effects whatsoever, the Hammond Company undertaking to bear and pay all liabilities, and also the costs of the agreement, and of winding-up and dissolving the Yorkshire Company, which will be proceeded with as soon as the amalgamation is carried out.

The Brazilian Submarine Telegraph Company, Limited.

THE twentieth ordinary general meeting of the shareholders will be held at the Cannon Street Hotel, on Thursday, at which the following report of the directors for the half-year ending June 30th last will be submitted:—

The revenue amounted to £87,856 11s.; and the working expenses to £12,800 9s. 10d. After providing £1,042 16s. 8d. for income tax, there remains a balance of £74,013 4s. 6d.; to this is added £9,421 0s. 2d., brought forward from the last half-year's account, making a total of £83,434 4s. 8d. A quarterly interim dividend amounting to £19,500 has been paid, and £25,000 transferred to the reserve fund, leaving a balance of £38,934 4s. 8d. The directors now recommend the declaration of a final dividend of 3s. per share, making a total payment of 6 per cent. for the year ended June 30th, 1883, and that the balance, £19,434 4s. 8d., be carried forward to the next account. An interruption occurred on September 22nd in the St. Vincent-Pernambuco section. Two hundred and sixty miles of new cable have been ordered, and arrangements made with the Telegraph Construction and Maintenance Company for the immediate repair of the fault, which the directors trust will be promptly accomplished. The question of duplicating the Madeira-St. Vincent and St. Vincent-Pernambuco sections, which with the duplicate Lisbon-Madiera section, laid last year, would provide a second line throughout the company's system, is engaging the earnest attention of the directors, and in view of the necessity for a large and immediate expenditure in repairs and duplications, the directors do not think it desirable to make any distribution of profits on this occasion beyond the 6 per cent. above mentioned.

Appended to the report is a statement of the traffic receipts, from the year ending June, 1875, to that ending June, 1883, as follows:—1874-75, £128,461; 1875-76, £129,038; 1876-77, £131,507; 1877-78, £134,003; 1878-79; £139,654; 1879-80, £154,957; 1880-81, £167,350; 1881-82, £174,185; and 1882-83, £175,927.

The balance-sheet shows that the company has sold 130,000 £10 shares, amonnting to £1,300,000; that its traffic and other credit balances equal £25,179 1s. 10d., and its reserve fund £370,941 12s. 8d., and that its unclaimed dividends and proposed dividend of 1½ per cent. amount to £24,476 10s., which, together with the balance carried forward, £19,434 4s. 8d., amount to £1,740,031 9s. 2d. Against this there are to be set, in investments, £347,591 8s. 6d.; spare cable, £17,406 6s.; by capital expended as per last account, and expenses of St. Vincent staff, £1,288,203 0s. 10d.; bills receivable, £11,102 7s. 11d.; remittances in transit, £258 3s. 7d.; traffic and other debit balances, £67,581 9s. 4d., which, with cash balances amounting to £7,888 13s., make up the credit side of the balance-sheet.

The "Brush" Electric Light and Power Company of Scotland, Limited.

AN extraordinary general meeting of this company was held at Dashwood House, New Broad Street, E.C., on Tuesday, Mr. Ashley Ponsonby presiding.

The Secretary (Mr. F. M. Brockelbank) having read the notice convening the meeting,

The Chairman said he regretted the absence of the Earl of Crawford and Balcarres, the chairman of the Company, through indisposition. They were only met to confirm the following resolutions, the confirmation of which, he moved, passed at the extraordinary general meeting of the company held on September 28th:—"That the company be wound up voluntarily under the provisions of the Companies' Acts, 1862 and 1867," and "That the Vice-Chairman, Mr. Robert Ewing, and Mr. Thomas Dickson be, and they are, hereby nominated liquidators for the purposes of such winding up, and that the remuneration of the liquidators be fixed by the shareholders."

Mr. Dickson seconded, and the motion was unanimously adopted.

The meeting then separated.

The West Coast of America Telegraph Company, Limited.—The secretary has forwarded us the following copy of a telegram received on Tuesday from South America, *vid* Galveston, and which relates to the messages forwarded and received by the new route:—"Lima reports to-day vast improvement; good dates from everywhere in South America, including the Brazils."

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

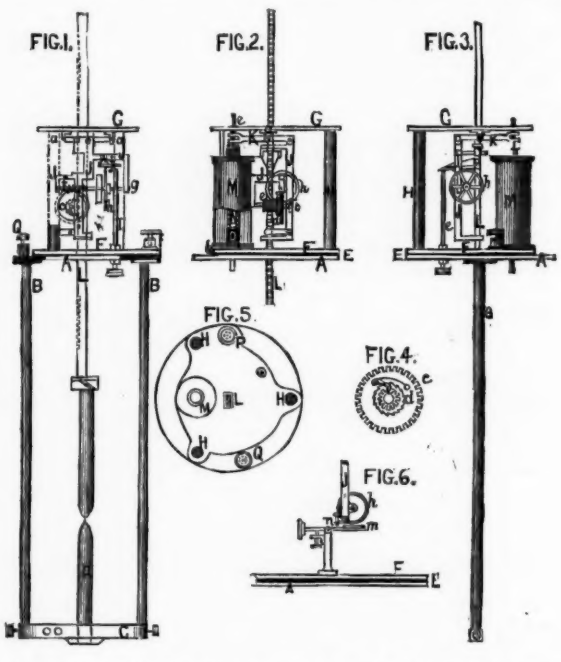
501. "Apparatus for electric lamps, chiefly applicable to stage purposes." J. G. SANDERSON. Dated January 30. 2d. Relates to those dances, such as Maypole dances, in which streamers are used, depending from a fixed or other centre, and the object of this invention is to construct a simple and suitable lamp-holder to form a coupling between the electric lamp and the wires which conduct the electric current from the machine. (*Provisional only.*)

508. "Primary voltaic batteries." G. G. ANDRÉ. Dated January 30. 6d. In an outer jar or box the inventor places one or more inner porous cells, and he charges the outer jar or box with a saline or acid solution, and the inner cell or cells with depolarising liquid such as a solution of sulphate of copper. In the outer jar he places a carbon electrode and a metallic electrode such as zinc, and in the inner cell or cells he places a metallic electrode such as copper, and he connects the carbon electrode in the outer jar with the copper electrode in the inner cell or cells by a wire or wires, so that these electrodes in themselves constitute a voltaic couple, and act together as a negative to the zinc. On closing the main circuit, the copper in the sulphate is thrown down upon the copper electrode, and sulphuric acid liberated, as in the well known "Daniell" cell; but on breaking the main circuit the voltaic couple, that is the copper and the carbon which are on short circuit through their connecting wire, come into action; and the copper which has been deposited on the copper electrode is now oxidised and re-converted into sulphate. It will thus be seen that the battery is regenerative, so that the depolarising substance which is used up while the main circuit is closed is being brought back into its original state during the time that the main circuit is open.

520. "Electric arc lamps." A. KRYSZAT. Dated January 31. 6d. Relates to improvements in electric lamps, and consists of a special arrangement and construction of the parts.

322. "Electric arc lamps." F. MORI. Dated January 19. 6d. Relates to electric arc lamps, the object of the improvements being to regulate the feed of the carbons at a rate proportionate to the consumption thereof, so as to maintain a uniform length of "arc," and also to provide means for the re-establishment of the current when the same has been completely interrupted. Figs. 1, 2, and 3 represent the simplest form of lamp, which is constructed as follows:—A, is a metal plate to the underside of which are

attached two arms, B, connected by a cross bar, C, which supports the lower carbon, D. Upon the plate, A, is a layer of vulcanite or other insulating material, E, which supports the mechanism of the lamp. F, and G, are metal plates connected by pillars, H (see plan view of fig. 5.) The parts marked, J, constitute the framework which is attached to the lever, K, the said lever being supported upon the pivots or fulcrums, *a*. Upon the spindle, *b*, are mounted a worm wheel, *c*, a ratchet wheel, *d*, and a pinion, *e*, the worm wheel being fast upon the shaft, whilst the ratchet wheel and pinion are loose. On the face of the wheel, *c*, is a catch which is pressed into the ratchet wheel by a spring, as shown in fig. 4. The rack L gears with the pinion, *e*, and to the bottom of this rack the positive carbon or electrode is attached, the negative electrode being supported by the cross bar, C. The worm wheel, *c*, gears with a worm, *f*, on the spindle, *g*, which also carries a wheel, *h*, upon the top of which rests a brake lever, *j*. M, is a solenoid, in the interior of which is a metal core, N, to the bottom of which is fixed a piston, O, fitting accurately within the cylinder of ths solenoid, and thus forming an air valve. The core, N, is connected at the top to the lever, K, which supports the framework of the lamp. The positive conducting wire is attached to the terminal, P, the negative wire being secured to the terminal, Q, and the solenoid wire is connected to the lamp at *k*, and *l*. When the



circuit is complete the attraction of the solenoid counterbalances the weight of the carbon and framework of lamp, and preserves the requisite length of arc, but when, owing to the consumption of the carbons the current becomes weaker, the weight of the rack and framework overcomes the attractive power of the solenoid and descends, thus bringing the carbon points closer together. As soon as the descent of the framework commences, the brake, *j*, comes in contact with the rod, *l*, and the pressure thereof is removed from the wheel, *h*. The weight of the rack and carbon acting on the worm wheel, *c*, is sufficient to cause the worm, *f*, to revolve, and thereby allow the rack to descend until the current is re-established, when the solenoid again commences to act upon the core, and the framework is again raised, and the carbon points separated so as to give the requisite length of arc. As soon as the framework is raised the brake, *j*, rests upon the wheel, *h*, and arrests the revolution of the worm, *f*. When the lamp is in operation the feed of the carbon requires to be very gradual, and for this reason the inventor employs two brakes for the wheel, *h*, the second one, *m*, being placed underneath, as shown in detail in fig. 6. The extent of motion allowed to the wheel, *h*, is consequently very slight, as no sooner does the frame begin to descend than the revolution of the worm is arrested by the brake, *m*. If, however, the current be completely interrupted the framework will descend until the carbon points come into contact, and the screw, *n*, will press upon the brake, *m*, and remove it from contact with the wheel. The current being re-established, the framework will rise, without separating the carbons, until the brake, *m*, again presses against the wheel, when the rotation of the worm, *f*, will be stopped, and the rack will be drawn up along with the framework, and the carbons separated to the required extent.

526. "Apparatus for electrical communication on railway trains." R. W. VINING. Dated January 31. 2d. Has for its object a simple plan of telegraphing between passengers, guards and engine-drivers in trains by means of electricity. It consists in giving the alarm by completing the circuit, and for convenience so as to only require a single battery. The latter is placed on the engine. (*Provisional only.*)

539. "Tram, rail, and road cars, &c., and machinery for driving same by electricity." M. R. WARD. Dated January 31. 6d. The object of this invention is to enable the speed of the motor to be adjusted as required without (sensible) increase in current. This result is obtained by an arrangement for altering the proportions of the speed, or in other words, by an appliance to obviate any great change in the resistance of the motor at different speeds of the car.

549. "Electric brushes and composition of the exciting liquid." MARY MCMULLIN. Dated February 1. 6d. In carrying out the first part of the invention, each element is composed of a platinum, silver, or carbon, plate or disc, inclosed in an insulating case of ebonite, or other suitable non-conducting material, with a metallic conductor or wire in contact with the plate or disc, and projecting through the insulating envelope. On the top of this plate, but insulated therefrom, is a zinc plate of equal size and shape, the two plates being separated by a pad of cloth, felt, or other suitable material. In contact with the zinc plate is also a metallic conductor or wire projecting through the insulating envelope. In and through the side of the insulating envelope is fitted a small tube, of any suitable material, through which the exciting liquid can be injected in sufficient quantity to saturate the cloth or felt pad between the two plates. The inner end of the tube is sufficiently long, and projects into the interior of the insulating envelope, to form a trap therein, and prevent the surplus liquid, if any, from escaping outwards, and the tube at the same time admits air into the interior for the purpose of depolarisation, &c. In carrying out the second part of the invention the inventor constructs the brushes with two or more rows of metallic bristles of suitable material, each row being insulated by non-conducting and intervening rows of hair bristles on the front of the brush, the ends of the metallic bristles being level with those of hair. The wire that binds the metallic bristles at the back of the brush is in metallic contact with each bunch of bristles, and runs the whole length of each row, leaving one free end to each separate row of metallic bristles, the free end of each being connected with the projecting wires of the battery hereinbefore described.

CORRESPONDENCE.

Protection of Shareholders.

Shareholders in electric companies are under great obligation to the ELECTRICAL REVIEW for its singular exception, as an independent commentator, upon the maladministration of these joint-stock bodies, for I fail to find in any other scientific journal a similar outspoken policy.

Your dissection of the accounts presented at the recent meeting of the Jablochkoff Company is well-timed; and if the shareholders present at such meetings allow their mercenary interests to bias their honest opinions, and to silence their voice, it becomes so much the more a manifest duty of the journalist to let the outside public know the truth, so as to afford them, at least, some degree of protection.

The speech of the chairman of the meeting in question is a suitable companion to accounts which, all things considered, are the most remarkable among the startling confessions of Boards electric in the present crisis.

Here, for example, we have £155,000 put down as the cost of "patents and goodwill," deducted from the shareholders' subscriptions, for a business showing a profit of £332 2s. 11d.; whereas if such £155,000 had been in the safe keeping of the shareholders themselves in any ordinary business, it would have brought them at least £7,000 a year, without any risk whatsoever. So much for the cutting irony of "patents and goodwill." The manifest question, however, is, how much has Mr. Jablochkoff got of this £155,000? This gentleman stands before the scientific world as an honourable man, yet whilst these monstrous figures remain there is an obvious obligation as a question of explanation, how it is such an unrighteous sum appears as being received by him, or by the Paris Company, for disastrous "patents and goodwill," as, according to the result of actual operations, they have been found positively worthless.

The chairman's address cannot be accepted seriously; facts are diametrically opposed to his logic.

Clearly the whole of the large sums charged against the shareholders should be subjected to a searching investigation. Here, for example, is an item for brokerage representing probably 50 per cent. of the present marketable value of the whole of the shareholders' paid-up capital.

Then those who have been in the immediate vicinity of the company's cash-box appear to have helped themselves pretty liberally in the shape of £1,754 for salaries, leaving, however, *£3* in the till as a remarkable example of self-denial. The directors also are on the scene at the general scramble, having "worked hard" for fees amounting to *£2,800!* two thousand eight hundred pounds for the management of a company resulting in a profit of *£332 2s. 11d.*

How do these gentlemen propose to regenerate the company? By contracting a loan for £20,000 at 7 per cent., which sum, after paying their debts of *£16,572*, would leave them an available money capital of *£3,428*; and according to the scheme of the chairman, there are to be eight directors to assist at the process of incubation of this mighty nest egg; but my painful experience demonstrates that the more directors there are the more jobs too frequently are hatched.

I have been a pained witness of the loss and suffering among many helpless subscribers to electric companies—to "patent and goodwill" companies, and I feel it to be one of the foremost principles of an independent Press to take the matter up and endeavour to protect the public by every legitimate means practicable.

A Shareholder.

[We consider the Jablochkoff Company's system to be very good in operation.—EDS. ELEC. REV.]

The Effects of Lightning.

Upon the above subject which appeared in your journal of September 29th last, I quite agree that Col. Parnell had a good deal of courage to express the opinion that "the addition of a lightning conductor (especially if of copper) would be simply adding fuel to fire."

I take it to mean that Col. Parnell believes a lightning conductor to be an additional source of danger, and he especially notifies a case like that of a pit's mouth, where cage, guides, winding ropes, &c., already contribute a mass of attracting metal.

In my opinion, such a place as this is more to be protected than any other, as the already existing mass of metal naturally tends to collect charge, and if this mass of metal is not continuous in its conductibility, there is most likely to happen a discharge through intervening material which is a bad conductor, and this I take to be the cause of all damage done to buildings by lightning discharges.

I also notice the remark—"Now my contention is this—Why generate this steam at all?"

Surely, Col. Parnell does not infer that the placing of a rod of copper in contact with the earth *generates electricity*.

It is not unnatural that many people in the United States should be against the use of lightning rods, as a man there who has failed in every other kind of business, generally starts for the last time in the lightning conductor line, but I contend that the fact that lightning rods are as a rule not properly connected to the earth, and to other adjacent metallic bodies leading to the earth, is not a cause for advocating their abolishment. The fact that lightning may sometimes prefer the rain water pipe to the lightning rod, is a proof, I think, that the water pipe was in better contact with the earth than the rod, and this would suggest that all lightning conductors should be electrically connected with all other adjacent metallic bodies leading into the earth.

With all respect for Col. Parnell's experience and his acquaintance with "Electricians," I think his views might be somewhat altered by an exchange of correspondence in your valuable journal.

Chas. W. Farquhar.

United States Electric Lighting Company,
Rotunde, Wien, *Oct. 10th*, 1883.

In reference to the interesting correspondence on lightning rods in your issue of to-day, I beg to send you a copy of the *Morning Post*, containing another letter from me on the subject, and from a somewhat different point of view.

A. Parnell.

13, Windsor Terrace, Newcastle-on-Tyne,
October 13th, 1883.

"The defence of life from the ravages of lightning is a subject that in all countries appears to have received a share of attention remarkably small as compared with the amount of consideration that has been accorded to the defence of property. In most civilised communities precautions are generally taken with a view to protecting from the effects of lightning important constructions, such as churches, public buildings, tall boiler chimneys, powder magazines, and large private mansions; but, so far as is known to the writer, nowhere are measures for the defence of life, as apart from property, that is to say, of life in respect of the rural classes and others who are obliged to spend most of their time in the open air, taken either by Governments, by public bodies, or even by influential private individuals. The idea that lightning strokes or (as they should accurately be termed) thunderbolts are sent, as it were, direct from 'the hand of God' is probably still prevalent in some rural districts. At the inquest held at Chatham in June last on the death of a poor little boy, Charles Henry Matthias, who two days before, being overtaken by a thunderstorm outside the town, had sheltered under a tree and was killed by one of these dreadful strokes, the jury returned a verdict that the deceased had met his death 'by the visitation of God.' It is not easy to understand why these plagues, any more than those of small-pox or cholera, should be assumed to be specially sent by God. It is also not quite comprehensible why efforts should not be made to avert thunderbolts in the same manner as attempts have been made to prevent small-pox. Jenner's success in this direction would seem to be a good omen for those who wish to adopt some general measures with a view to the release of country labourers and cottagers from the dangers to which they are now liable by thunderstorms. We talk and write a great deal about preventable mortality, and we enforce wholesome sanitary arrangements in all our large towns. May we not with great advantage endeavour to diminish some of the mortality to which our comparatively untaught, ill-to-do, and very patient brethren of the field and the plough have for so long been subject? Perhaps one of the great stumbling blocks in the path of philanthropists who may have reflected on the liability of country persons to the calamities by lightning, from which townsfolk are almost free, is the undoubted fact that even in the isolated cases afforded by important buildings where defensive systems have been adopted, the principle of these systems has not been to attempt to prevent thunderbolts, but to attempt to cure the buildings (so to speak) after the thunderbolts have occurred. Such is the exact theory on which the apparatus known as 'lightning conductors' have been established. The main action of these metallic arrangements is universally understood to be (as their name implies) the conduction down a channel specially prepared for it on the outside of the building of the lightning (treated as a species of fiery fluid) in its supposed descent from the clouds into the bosom of the earth, where it is assumed that this destructive agency becomes harmlessly dispersed. Some little advantage is occasionally admitted to accrue from the tendency of the sharp point, with which most, but not all, of these 'conductors' are surmounted, to tap the electricity, whose excessive accumulation admittedly causes the stroke, but (in England at all events) this function of the point is little valued, and generally only mentioned in a casual sort of way. Now the experience of all countries and of all ages has clearly indicated that metal is in some way attractive to lightning, and in these days the advocates of lightning rods (the name by which 'conductors' were originally known) do not deny that these instruments attract the lightning, but they contend that, having attracted it, the rods lead it away so that it effects no harm. They consider a 'lightning conductor' efficient and successful when it is struck and the building remains uninjured. So far, then, from preventing lightning strokes 'electricians' actually invite them in order to lead them away harmlessly. In all this they look solely to the effect and entirely neglect the cause. They forget to ask themselves the very pertinent question—Why should any building ever be the scene of a thunderbolt? They tacitly assume that under any circumstances—whether the house had 'conductors' fixed to it or not—the stroke would have occurred. Herein, however, lies their vital error. For by electrical law whatever tends to attract, *i.e.*, to be struck by, lightning, necessarily tends to cause it. Lightning is simply an effect of certain causes. It is an explosion of pent-up electrical force. It is a sudden and violent discharge of accumulated charge. Its action is like the bursting of an overcharged boiler. Now all experience shows in the most conclusive manner that metal exposed on buildings either tends to increase the accumulation of charge or to lessen the restraint to explosion caused by the air. To speak metaphorically, metal either causes a greater steam pressure or it diminishes the thickness of the boiler plates; and in both cases it invites explosion. The lightning conductor expert is apparently on the same footing as a medical man who should first insidiously inoculate his patient with the germs of disease, should then (provided all his remedies were skilfully applied) cure him, and should then pose before the laity as a benefactor of mankind. Naturally, with these ideas in regard to precautionary measures against thunderbolts, not much progress has ever been made towards preventing the occurrence

of these direful strokes amongst the peasantry. Again, the knowledge of the fatally attractive property of metal during thunderstorms has always been widely spread and deeply rooted among the labouring classes, and their common sense has never yet fully explained to them how this same metal, if it were only arranged in a particular form, should become beneficial instead of dangerous. As well, they would probably argue, might sanitary people urge that if foul matter and filth were only arranged in a peculiar manner around one's back-yard, the refuse would not only cease to be noisome and deadly, but would in reality be sweet and wholesome. The chances, therefore, are very strong that even if the great costliness of lightning-rods could ever have permitted their extended application the country people would steadily have resisted any attempt to avert danger from their houses by placing more metal on them.

"The scope of this paper is not, however, to discuss lightning-rods or other arrangements intended for the defence of property, but to call attention to the question of the saving of life in rural districts. The writer has for several years amassed details of lightning accidents, the circumstances and results of which he has closely analysed and classified. In this manner he has (up to date) examined nearly 700 cases of thunderbolt action that have occurred in various parts of the world during the last 200 years. These cases include about 120 separate instances of fatality to human life, besides many others in which the injuries were not deadly; and the broad conclusion that the writer has arrived at in regard to the best means of helping the country labourers is simply this—Government should for a few years scientifically investigate and minutely record every instance of fatal or destructive thunderbolt that should occur during that time within the United Kingdom. An inspector should for this purpose be appointed to visit the scene of every injury and to investigate all the circumstances thereof, just on the same plan as an inspector is sent to visit and report on every railway accident that happens. So soon as experience (including all obtainable facts already recorded) should have accumulated to a degree warranting the assumption of certain laws, physical, meteorological, and geographical, according to which thunderbolts should appear to guide their actions, Government would then be in a position to consider the advisability of some definite course of treatment as regards either the whole country or any particular district, basin, or county. During this time the inspector would be able to compile a great deal of scientific information from the various learned societies, from foreign countries, and from every available source, as to the action of terrestrial electricity generally, including the operations of such phenomena as earthquakes, earth-currents, aurora, magnetic storms, St. Elmo's fires, meteors, and whirlwinds. If once we obtain reliable data on which to guide our policy in regard to the defence of life, we need not particularly concern ourselves with the question of the defence of property, for the greater subject would comprise the lesser. Pending, however, the collection of further information by means of a systematic authoritative agency, we would submit some brief suggestions, based on the experience already gained, in the hope that perhaps precious lives may be saved through the knowledge of a few simple, easily-remembered rules. Some of these rules may often be quite impracticable of execution, but it is as well to insert them, since a perception of their tendency and principle will be useful. Space will not permit (as would be desirable) each rule to be accompanied by its appropriate physical reason; but a few hints will be given by way of elucidation. (1.) Persons working in the open air should carry about them as little metal as possible. This is a rule which, unlike most rules, admits of no exception or qualification whatever. It is of the most intense importance. The manifold ways in which metal is apt to be present about one's person should be carefully considered. Let us mention some of the principal instances. Boot nails, trouser buttons, buckles, money, pencil cases, keys, mountings of tobacco pipes, match boxes, rings, watches, watch chains, trinkets, pins, studs, earrings, brooches, mountings of walking-sticks and umbrellas. (2.) Labourers leaving their field work when a thunderstorm approaches should by no means take away with them any tools or implements. (This follows on 1—hayforks, hoes, scythes, sickles, spades, &c., are all very dangerous.) (3.) Unless there should be close at hand some brick or stone house, in which the labourers can enter, they should, as the thundercloud comes near, on no account move, but (careless of the rain) they should lie flat on their face on the ground till the clouds have passed over them. It is very dangerous to be caught in motion, and the object of lying down is to diminish the attractive element of height above the ground. (4.) Shelter of all kinds must be most carefully avoided. The shelter afforded by trees, hedges, banks, hayricks, walls, porches or doors of houses, cliffs and sheds, is all equally deadly. If only this one rule were well known, many hundreds of lives would be saved. It ought to be emblazoned on, say, the doors of every parish church in the country. What signifies a wetting on a warm summer's day to a hardy labourer? It is the vertical or elevated element of the shelter that facilitates explosion and hence tends to cause thunderbolts to occur. (5.) Shun the cover afforded by barns, by outhouses, and by wooden buildings generally. A wooden building is more dangerous than most persons imagine. A wholly wooden house is more dangerous than a wholly metal one, on account of the absence in the former of the elements in the latter tending to electric leakage. (6.) Think of the ground beneath your feet rather than of the cloud above; and if you have time select on the following principles the ground on which you intend to lie flat or to wait: choose low ground rather than high, retired sites rather than prominent ones, dry places rather than wet, pavement or road rather than grass or earth, and leeward sites rather than windward ones. In every lightning stroke the explosion is double. It springs upwards from the ground and downward from the cloud simultaneously; and the portion which affects denizens of the earth is the upward or ground stroke. The nature of the soil and the circumstances of the site are therefore very material elements in the formation of lightning strokes. Elevation, exposure, water, vegetation, and ready accessibility, as it were, to the influence of the approaching cloud all tend to cause thunderbolts to occur. (7.) Whilst a thunderstorm is in process kitchens of country houses and cottages should always be vacated. The kitchen fire is generally alight, the chimney is more or less sooty, the grate presents a large surface of metal, and it is on the basement or lowest floor, and therefore close to the origin of the thunderbolt; all these (besides the elevation of the chimney stack and the existence of the flue) are dangerous elements. When the cottage is struck the kitchen is nearly always the charnel-room. (8.) In every room the fire-places, the walls, and especially the metallic articles on or near the walls, should be avoided. Among the metallic objects alluded to the following may be noted:—Balconies, rain-water pipes, gas pipes, water-supply pipes, bell wires, picture frames, gildings, pianos, bedsteads, tie rods, ventilators, window fastenings, door fastenings, and looking-glasses (on account of the mercury). (9.) All doors and windows should be closed. The dry air of the house is less facilitative than the wet or damp air outside. (10.) There should be a minimum of metal in elevated positions on the outside of the house or cottage. The great cause (besides the chimneys) of buildings being struck is the presence on or near their roof of elevated metal, *e.g.*, chimney pots, vanes, tie bars, eaves gutters, rain-water pipes, lead flushings, or metal roofing. (11.) The ground immediately around the building should be dry and well drained. (See No. 6.) A strip of pavement close round the walls is a great advantage. (12.) The kitchen grate should have a vertical bar of iron fixed to the bottom of it, and led through the hearth into the ground immediately below to a depth of about 6 inches. At the same time a few sharp-pointed iron spikes about 3 inches long should be fixed on any convenient part of the grate. This arrangement converts the grate into an apparatus which taps the electricity of the ground, and tends to prevent the occurrence of lightning strokes at the house or cottage. This measure is far more efficacious than a 'lightning conductor' would be, and the expense is merely nominal.

"In conclusion, I would submit that if owners of property or farmers would construct in convenient places among their fields cheap masonry buildings, in which their labourers, especially the women, might take refuge during thunderstorms considerable advantage would ensue. Such constructions would doubtless always be of use for farming operations.

"A. PARNELL, Colonel (late Royal Engineers)."

The Hammer Telephone.

On my arrival in London, I find the short reply of Mr. F. W. Cooke to my letter inserted in your issue of September 15th. When invited to reply to his questions about the theory of my Hammer telephone, I was glad to give him as much satisfaction as possible. I have no doubt Mr. F. W. Cooke will follow my example by publishing his own views, which, he says, are not the same as mine, and perhaps he will add some evidence to prove the truth of his theory.

These details would be of the greatest interest to me before the publication of the complete work I am now preparing.

Leon De Locht-Labye,
Honorary Mining Engineer.
24, Langham Street, Portland Place,
London, W.

Telephoning through the Human Body.

Having heard that it was possible to transmit articulate speech through the human body by means of telephonic instruments, I made several trials with some novel telephonic instruments sent to me from the United States by the inventor. I regret that I cannot at present send you a description of these instruments, because patents therefor have not yet been secured in all foreign countries. With these instruments, using at each end of the circuit two medium size Leclanché cells, using two metallic conductors, one of which was severed, and the two ends stripped of its covering about one inch in length, one end held in a wet sponge in one hand, the other end also held in a wet sponge in the other hand, conversation was carried on, and every word was rendered clearly and distinctly, and sufficiently loudly.

W. C. Barney.

Oct. 16th, 1883.